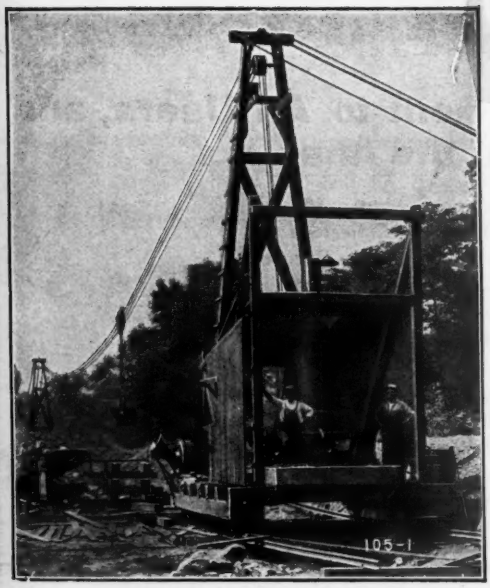
Pit and Quarry

SAND • GRAVEL • STONE

HANDLING • CRUSHING • SCREENING • WASHING



CABLEWAYS
FOR
QUARRY or SAND PIT

Mundy Hoists

will handle your material quickly and cheaply..

Let us submit you our proposition.

STEAM OR
COMPRESSED AIR

ELECTRIC, GASOLINE
or BELT DRIVEN

J. S. Mundy Hoisting Engine Co.

HOISTING EQUIPMENT — NEWARK, N. J.

NOVEMBER, 1918

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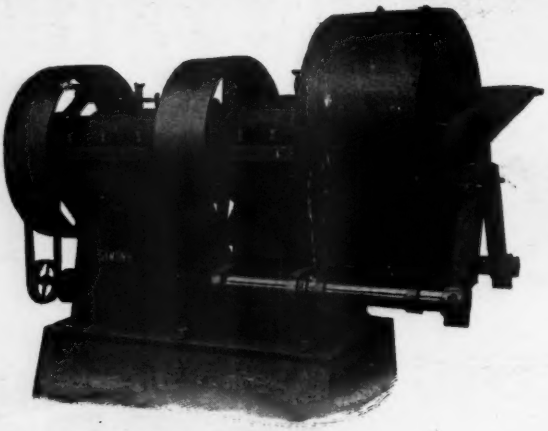
SYMONS DISC CRUSHER



READY FOR IMMEDIATE DELIVERY

Questionnaire Sent to All Users, and One of the Answers

Q. Size crusher this report covers? Ans. *48 inch.*
Q. Kind of material crushed? Ans. *Limestone.*
Q. What moisture in material? Ans. *No Record.*
Q. How long have you operated crusher? Ans. *3 years.*
Q. What is size of feed? Ans. *4 inches.*
Q. What is size of product? Ans. *1½ inch.*
Q. What horsepower does it require? Ans. *65.*
Q. How many tons per hour does it crush? Ans. *80 to 100.*
Q. How many tons do you crush per pair of discs? Ans. *750,000 tons.*
Q. What percentage of time have you lost on account of breakage? Ans. *None.*
Q. Give your opinion of this crusher as compared to rolls. Ans. *Would not use rolls.*
Q. Give your opinion of this crusher as compared to a jaw crusher. Ans. *Superior to Jaw crusher.*
Q. Give your opinion of this crusher as compared to a Gyratory crusher. Ans. *Superior to Gyratory crusher.*

Signed *Name on Request.*

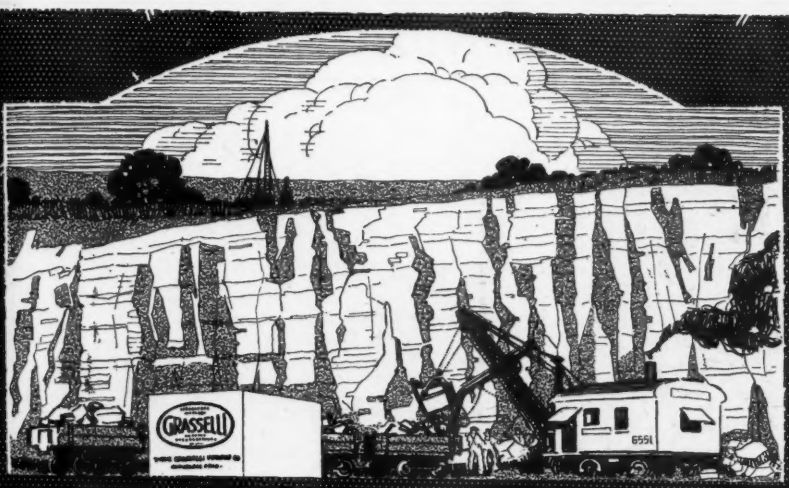
Many more like this, also reports of the success of the crusher on different kinds of material.

Also built in sizes 18 in., 24 in. and 36 in.

Manufactured and Sold Only by

Chalmers & Williams

CHICAGO HEIGHTS, ILL.



GRASSELLI EXPLOSIVES

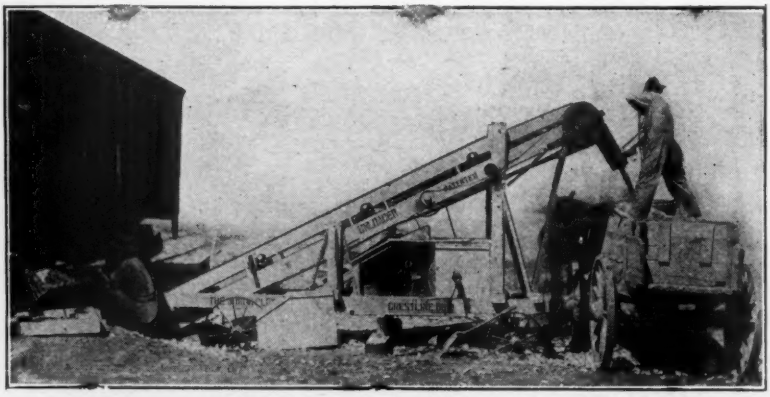
A long standing reputation for unvarying satisfaction and quality is the warranty that has established a bond of confidence between The Grasselli Powder Co. and Pit & Quarry operators.

While every resource of the "Grasselli" organization is pledged to do all in its power to speed the day of victory, we point with pride to our years of conscientious service and our record of accomplishment. When the final triumph of Democracy is consumated The Grasselli Powder Co. will again prove its right to its place in peaceful industry.

We will be glad at any time to furnish information regarding "Grasselli" explosives.

THE GRASSELLI POWDER CO.,
Cleveland, Ohio.

A Yard a Minute—



will keep the wagons moving. That rate of speed is easily averaged with the

BURCH CAR UNLOADER

Some users exceed that pace. Fast loading is necessary, but low operating cost of the machine is essential. The simple, practical design of the "Burch" eliminates the need of several shovelers. It is sturdy and compact, capable of withstanding the most severe use.
You ought to also know about our stone spreader used in connection with motor truck in spreading stone or gravel on road.

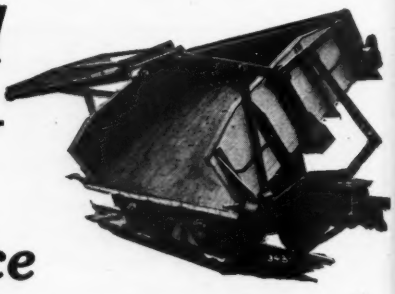
Write for Complete Details

THE BURCH PLOW WORKS COMPANY - - CRESTLINE, OHIO

Continental Cars ——

for all kinds of

Quarry Service



CONTINENTAL CARS are noted for their ruggedness, simplicity of design, ease of dumping and righting, and their ability to stand up under the heaviest steam-shovel work.

Large wheels and heavy truck construction make CONTINENTAL CARS cling to the track.

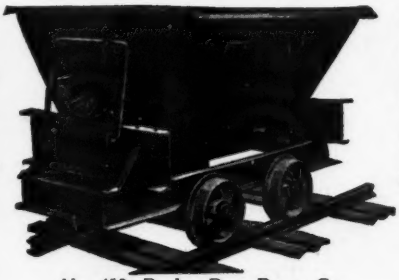
MALLEABLE CASTINGS reduce the maintenance cost to a minimum. *Send us your inquiry.*

Continental Car Company of America, Incorporated

Main Office and Works, Louisville, Ky.

SACKETT DEPENDABLE CARS

FOR QUARRY AND PIT SERVICE

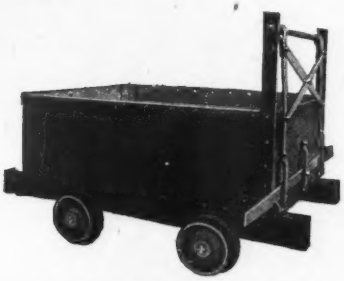


No. 450 Rocker Race Dump Car

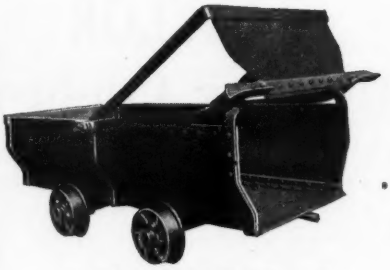
Economically designed and built for Strength, Utility and Rough Usuage.

Several types. Side and end dump.

Suitable Capacities, Roller Bearing or Self-Oiling Wheels.



No. 430 End Dump Quarry Car



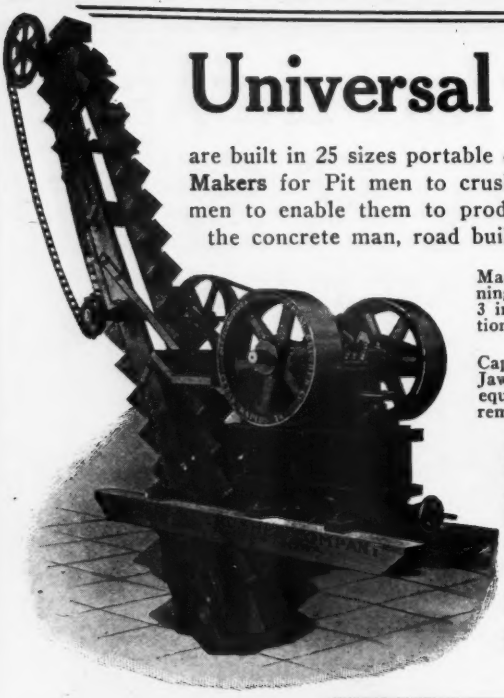
No 431. Bent Side End Dump Car

Also supply industrial track switches, turntables, 12 lb. to 30 lb. rail, with steel ties, bars, bolts and clips.

We manufacture Hand and Power Revolving Screens, Chutes, Skips, and other Quarry Equipment.
Write for catalogue and prices.

H. B. Sackett Screen & Chute Company

Office and Factory: 1682 Elston Avenue - CHICAGO



Universal Crushers

are built in 25 sizes portable or stationary, and are **Money Makers** for Pit men to crush their oversize and Quarry men to enable them to produce small crushed stone for the concrete man, road builder and contractor.

Machines can be adjusted while running, to produce material varying from 3 in. to as fine as ¼ in. in one operation.

Capacities from 5 to 300 tons per day. Jaw openings 5x6 to 14x24 inches equipped with manganese jaws and removable bronze bearings.

Send for Catalogue of full line of Universal and Eureka crushers, rolls for fine grinding, Elevators and screens of all sizes, also full line of Universal Pulverizers for the manufacturing of Agricultural Limestone and the grinding of other fine materials.

UNIVERSAL CRUSHER CO.
200 Third Street, Cedar Rapids
Iowa, U. S. A.

TRAYLOR
Gyratory Crushers

with their extra large shafts—eccentric both longer than others and of greater diameter, entirely submerged in the lubricant

ASSURE YOU

of a cool running Crusher, having the maximum capacity with the cost of upkeep reduced to the minimum.

Bulletin QG-4—It's New
Get It.

Traylor Engineering & Manufacturing Co.

Main Office and Works:
Allentown, Pa., U. S. A.

New York Chicago Los Angeles Spokane

The Largest Agricultural Limestone Producers

USE

The Bradley Three Roll Mill

This mill is in use by more large producers than any other machine made—produces more material and at a lower cost.

No auxiliary machinery or screens needed to procure the very finest finished product—takes rock ¾" in diameter and reduces to shipping fineness in single operation.

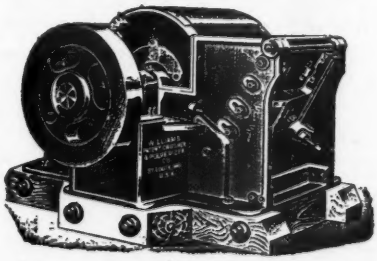
The Demand for Finely Ground Limestone Is Increasing. Why Not Prepare Now?

Send for Catalog No. 42—Our Engineering Dept. Is at Your Service

Bradley Pulverizer Co.

BOSTON **London** **Works—ALLENTOWN, PA.**

FROM 14" TO 18" CUBES TO 1½"- 1"- ¾"- ½" IN ONE OPERATION



BY using Williams Jumbo Crushers to take the feed from the very large Gyratory Crushers, the smaller or intermediate crushers, which were formerly necessary, can be eliminated as the Williams Jumbo Crusher will reduce these large cubes ranging in size from 14" to 18" to a product either 1½"-1"-¾" or ½". Capacities from 60 tons per hour to 200 and 300 tons per hour. Complete description of this extraordinary crusher is given in

BULLETIN NO. 85

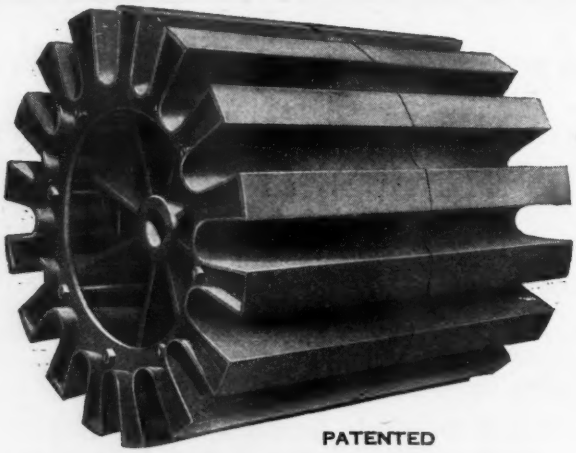
THE WILLIAMS PAT. CRUSHER & PULVERIZER CO.

Gen'l Sales Dept., Old Colony Bldg.,

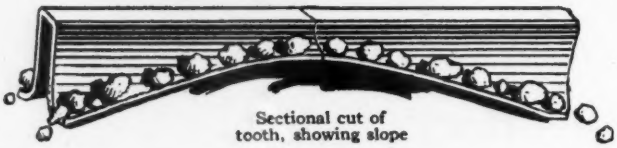
CHICAGO

Plant: St. Louis, Mo.

7 Second St., San Francisco, Cal. **First National Bank Bldg., Denver, Colo.**



PATENTED



Sectional cut of tooth, showing slope

The "Black" Elevator Boot Pulley

Entirely eliminates the trouble and much expense and loss of time caused by shut downs due to the replacing of elevator belts in crushing plants.

These belts wear out rapidly due to the cutting and bruising action of stones which fall between the belt and boot pulley.

Insure yourself NOW against further loss. Our new catalog explains the special advantages obtained by their use. Write for copy.

Allis - Chalmers Manufacturing Company
MILWAUKEE, WIS.

OFFICES IN PRINCIPAL CITIES

Canadian Business Refer to CANADIAN ALLIS-CHALMERS, Ltd., TORONTO, ONT.

Avoid Crusher Troubles

The Superior-McCully Gyratory Crusher has features that you will find in no other standard type of gyratory crusher. Its new improvements will end your crusher troubles. Designed to overcome the faults usually found in gyratories, this machine from the start has enjoyed a remarkable success. Over 100 now in use.

THE NEW SUPERIOR - McCULLY GYRATORY CRUSHER

(Patented)

Life of "Eccentric and Gears" are lengthened 200% because all dust and grit are absolutely excluded and Cut Gears run quietly in oil.

Main Shaft is 60% stronger than Standard Gyratories of corresponding opening. Area of eccentric 100% greater than any other machine of equal size. Capacities—30 to 1000 tons per hour, built in sizes from 10″ to 54″ opening.

Recent orders received for Superior McCully Gyratory Crushers from prominent Lime and Cement Manufacturers.

Lehigh Portland Cement Company,
International Portland Cement Co.,
Cuban Portland Cement Co.,
Standard Lime and Stone Co.,
Rock Cut Stone Co.,
Lehigh Stone Co.

Let us tell you how we overcome common crusher troubles.

Ask for Bulletin

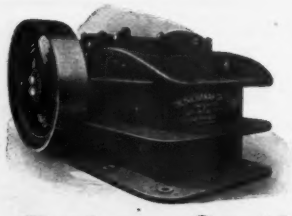
WORTHINGTON PUMP AND MACHINERY CORPORATION

New York Office, 115 Broadway. Power and Mining Machinery Works, Cudahy, Wis.

Chicago Office, 820 Old Colony Building

Branch Offices in All Principal Cities

M475.8

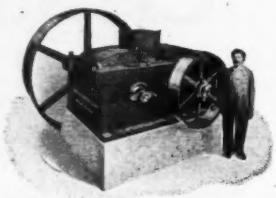


Buchanan All-Steel Crushers

Type B—12 sizes, from 5x12″ to 24x36″. Manganese Steel wearing parts, Water Jacketed Bearings, Parting Pitman in larger sizes, adjustable jaw stroke. Type C—24 sizes, 24x36″ to 60x84″.

Buchanan Crushing Rolls

Type C—sizes from 18x12″ to 42x16″. Type C Special from 42x18″ to 72x24″. Phosphor Bronze Bearings, Chrome Steel Tires, Patent Swivel Bearings, Fleeting Adjustment, Dust Covers.

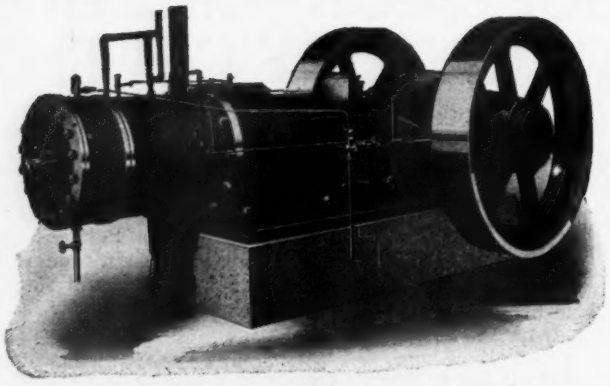


Buchanan Magnetic Separators and Magnetic Pulleys

Protect your machinery against breakage from tramp iron and steel.

C. G. BUCHANAN CO., Inc., 90 West St., New York, U.S.A.

THE ANY-PURPOSE OIL ENGINE



Can be used in any method of power transmission.
Burns the widest range of fuel—crude oil or any of its by-products.
Starts automatically.
Amply guaranteed in regard to material and workmanship.

A Size and Type for Every Need Illustrated in Our Catalog

THE POWER MFG. CO., Dept. No. 3 **MARION, OHIO**

Visit Our Big Modern Plant

Sterling MOTOR TRUCKS

Deliver on Time --Shorten Long Hauls

FOR hauling units and fleets Sterling dump trucks are designed and constructed to meet all hauling requirements of contractors. Have strength without weight and capacity without burden.

---With the Wood-Inlaid Frame

Shocks are life destroyers—maintenance and inspection expense creators—but 11 years have proved that the Sterling oak-inlaid frame means long life to the motor and power plant—minimum idle hours or days for repairing—the most satisfactory constant availability—always on the job, for service.

Built in 2½, 3½, 5 and 7-ton capacities—bodies for any specifications.

Our well equipped distributors and service stations in leading cities properly represent factory standards and established service policy.

Write for Hauling Facts

STERLING MOTOR TRUCK COMPANY

Builders of Motor Trucks Exclusively for 11 Years

MILWAUKEE, WISCONSIN

"First Repairs in 2½ Years"

THAT'S the phenomenal record of a Gramm-Bernstein truck belonging to J. F. Silver of Carsonville, Mo. It is another of the numerous examples of unusual reliability these trucks are giving all over the world.

Send for full data.

The Gramm-Bernstein Motor Truck Co.

Lima, Ohio

DETROIT WEATHERPROOF TOPS — OLYMPIAN CARS — GRAMM-BERNSTEIN TRUCKS

Welling Motor Company

5033 DELMAR BLVD.

ST. LOUIS, MO.

June 10, 1916

JUN 12 1916 GRAMM-BERNSTEIN

Gramm-Bernstein Motor Truck Co.,
Lima, Ohio.

Gentlemen:--

We have had our first occasion to repair a Gramm-Bernstein truck. This truck belonging to Mr. J. F. Silver of Carsonville, Missouri.

This is the most remarkable case the writer has ever heard of. The repair bill was $31.00 and he stated that after using the truck two and one-half years, this is the first repair bill he has ever had.

Also stated that he never removed the spark plugs and it seems to us that this is true as the spark plugs were almost impossible to remove from the cylinder.

He averages about forty (40) miles a day. Isn't this wonderful?

The writer is going to have a photograph made of the truck with Mr. Silver, showing the happy Gramm-Bernstein owner. We beg to remain

Very truly yours,

WELLING MOTOR COMPANY.

Conrad A. Welling

CAW:FK

FEDERAL

Another FEDERAL

3½-ton Federal used by T. B. Bidwell, Tacoma, Wash. "Best truck ever built," he says.

"The Best Truck Ever Built"

—says Mr. T. B. Bidwell, who is using a Federal 3½-ton Truck for hauling sand and cement for concrete paving near Tacoma, Wash. This work is one of the hardest tests of a truck—and when he says that his Federal is the "best truck ever built" it should have a real meaning to other contractors.

Federal stamina, ruggedness and great economy are features which mean greater profits in every line of contracting work.

Write us and we will send you regularly the magazine, "Traffic News," a publication for truck owners and buyers.

Federal Motor Truck Company
44 Federal Street **Detroit, Mich.**

KEYSTONE 10-TON TRACTION STEAM SHOVEL

HERE IS A LIGHT TRACTION STEAM SHOVEL that will go anywhere you could take a loaded dump wagon. A 15-mile jaunt in ten hours, over decent roads, is easy for it.

IF YOU HAVE A STRIPPING JOB, or if you wish to accurately separate two strata of clay or sand, the flat bottom half-yard SKIMMER SCOOP will do your work as nothing else could.

IN SHALLOW CUTTING, 6 in. to 2 ft., this little shovel will beat the big ones in daily output. Its 16-ft. boom and 11-ft. horizontal crowding movement give it the bulge on shallow work.

And it will DRIVE ITS SCOOP INTO THE TOUGHEST FIRE-CLAY, gravel, shale or anything, in fact, but solid rock.

There are dozens of KEYSTONE excavators DIGGING BITUMINOUS COAL, in open pits.

You can LOAD FROM STORAGE PILES of crushed stone, sand, gravel or coal, into freight cars, industrial cars or wagons.

And you can get around quickly from your quarry to your storage dump and vice versa.

AGAINST A HIGH BANK of sand or clay, where all strata are to be mixed in digging, you would, of course, use the DIPPER SCOOP, which works like the ordinary type of steam shovel.

When necessary to cut below grade, as in working around the top of your quarry face, you should use the DRAW DITCHER SCOOP, which is a positively controlled dragline attachment, cutting toward the machine and to a depth of 16 feet below grade.

The machine can be thus equipped WITH THREE DIFFERENT SCOOPS AND ATTACHMENTS: The Skimmer, Dipper and Ditcher. They are inexpensive and you can change from one to another in a few minutes. The cost is low.

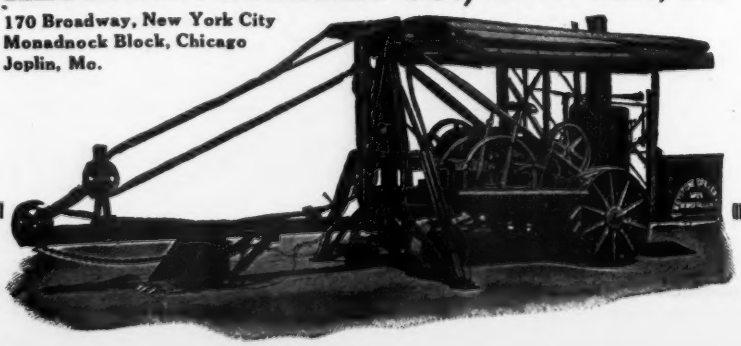
It will give you confidence to know that, while the Keystone Shovel is comparatively a newcomer, there are already over 400 of them in use among contractors and quarrymen, and they have won enthusiastic approval.

Besides, the machine is sponsored by the Keystone Driller Co., which is by no means a newcomer in the manufacturing field, having been in business at Beaver Falls, Pa., since 1882.

The photographs reproduced in OUR SHOVEL CATALOG show the machine on dozens of different jobs and they will show you more in a minute than we could tell you in an hour. They are supplemented by many pages of cuts reproduced from drawings prepared by our Engineers. The accompanying text is fully descriptive and contains such data as you will require to determine what could be expected of the Keystone Excavator on your work. Drop us a line NOW.

KEYSTONE DRILLER CO., Beaver Falls, Pa.

170 Broadway, New York City
Monadnock Block, Chicago
Joplin, Mo.



Because—

DYNAMITE

Will Do Your Work Right

is the reason you should use it. We have a variety of grades—they will suit your particular needs, no matter in what manner they are connected with blasting.

Many users have individual blasting problems to solve. To such, we offer our consultation services, and we will also make an exhaustive study of your requirements, gratis. Then our recommendation of proper grades is at your disposal—whether you take advantage of it or not.

Could you ask for more?

ÆTNA EXPLOSIVES COMPANY

Incorporated

120 Broadway New York City

Gyradisc

Pit and Quarry

A Monthly Journal for Producers of Sand, Gravel, Stone, Cement, Gypsum and Lime
Member Audit Bureau of Circulations

VOL. 3 CHICAGO, ILL., NOVEMBER, 1918 NO. 2

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PIT AND QUARRY is published at 875 Rand-McNally Building, Chicago, Ill. Subscription price, $1.50 per year.
Contributors and advertisers should have copy in the office by the 15th of month preceding publication, as forms close at that time.

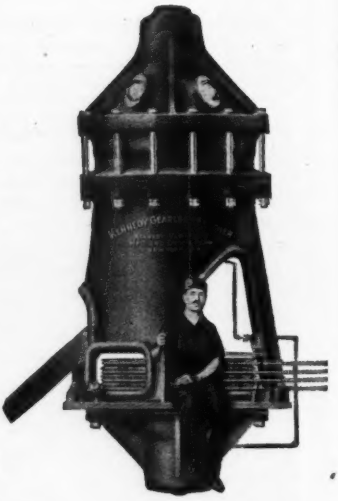
The Machine that meets the demand of years is here

The KENNEDY GEARLESS CRUSHER

ONE Crusher of this type has a capacity, when crushing to ¾ inch and finer, of approximately SIX No. 3 Gyratory Crushers, giving an enormous output of fine product.

It is a strong, rigid machine, made throughout of best materials. Is driven by one belt or rope sheave. Power required is little for the tonnage produced. Crushing parts are entirely enclosed, making machine practically dustless.

These are only a few of the advantages of this remarkable Crusher.



We have the largest line of Mining, Crushing and Cement Machinery of any concern in the world. Send us your inquiries.

Ask for Catalogue No. 24.

Kennedy-Van Saun Mfg. & Eng. Corp.

Equitable Building **New York City**

ERIE Revolving Shovels

BALL Engine Co. Erie, Pa.

"With one ERIE Shovel and 18 or 19 men, we are now getting the same output which formerly required 40 to 50 men.

"Besides this big saving in our pay-roll, we now have the assurance of a steady output, every day.

"After using two ERIE Shovels in hard quarry service, we can conscientiously recommend the ERIE."

L. Suzio, Pres't YORK HILL TRAP ROCK QUARRY CO., Meriden, Conn.

"Replacing 20 to 30 men; Sure of rock every day!"

Even in a quarry which employs only 15 to 20 men, a good steam shovel will usually save money. It's worth your while to figure this carefully.

We will be glad to send you our latest Bulletin on steam-shovel work—write for a copy of Bulletin "Q." Address

BALL ENGINE CO., ERIE, PA.
Builders of ERIE Steam Shovels and Cranes; BALL Engines.

Pit and Quarry

Vol. 3 Chicago, Ill., November, 1918 No. 2

Uncle Sam a Big Customer

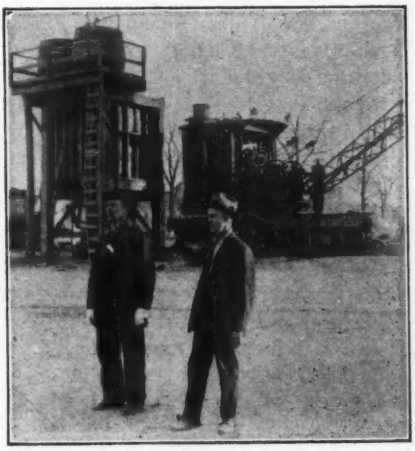
France Stone Company's Splendidly Equipped Plant at Monroe, Mich., Turns Out 4,000 Tons a Day.

PRODUCING 4,000 tons of crushed limestone daily, the Monroe, Mich., quarry of the France Stone Company, of Toledo, Ohio, is playing its part in the war. M. L. McCreary, superintendent, estimates that at least 95 per cent of the product goes into war work, directly or indirectly. Most of it is taken by railroads for ballast. Stone for concrete construction purposes, used in building war plants, furnishes an important source of demand. The Dixie highway, one of the few roadbuilding projects in the section not abandoned on government order, consumes large quantities of stone. The dust is sold for agricultural use.

Having direct connections with the New York Central and Michigan Central railroads and with the Detroit, Monroe and Toledo Short Line electric railway, and good facilities as well for switching onto the Pere Marquette and Detroit and Toledo Shore Line railroads, the plant is well situated in the matter of transportation.

Of the fourteen stone-crushing plants operated by the France Stone Company and subsidiaries, the Monroe plant is one of the best equipped. Two Marion steam shovels are kept constantly at work in the quarry, digging out the stone. Two Vulcans, made in Toledo, are used for stripping. The two well drills used are Clippers, made by the Loomis Machine Company. Four locomotives draw the stone from shovel to crusher house. A Lidgerwood hoist, driven by a 300-horsepower General Electric motor, pulls the cars into the crusher house, where they are dumped into an Allis-Chalmers Gates type mill, type 21, which will crush stone up to 42 inches in diameter.

A 90-foot Allis-Chalmers pan conveyor, 48 inches wide, lifts the crushed rock to a pair of Allis-Chalmers separating screens 16 feet by 60 inches. The rejections are delivered to a battery of Allis-Chalmers crushers of Gates type, consisting of two 5s, a 6 and a 7½, which reduce it to marketable size.



Master Mechanic Ernest J. Miller and Supt. M. L. McCreary.

Master Mechanic Miller and the Big Gates Crusher.

The stone is then delivered to a 36-inch Boston belt, 500 feet long, of ten-ply canvas, treated with rubber, which conveys it to the screen house. Here it goes into a set of Allis-Chalmers screens, 60 inches by 16 feet, and smaller sizes are dropped to smaller screens of varying sizes, delivered to bins and from these to cars, which are shunted to raised sidings and sent to the chutes by means of gravity. Two locomotives of standard gauge are kept busy in the yards moving these cars. The equipment also includes a Brown locomotive crane, made by the Brown Hoisting Machinery Company.

Electricity supplies all the power used in the plant proper. It is furnished by the Toledo Railways and Light Company, from a distance of more than 30 miles, in a 4,000-volt circuit. This is stepped down to 440 volts for the motors and 110 for the lighting circuit. Seventeen motors are used, with an aggregate of 1,000 hp. Ernest J. Miller, the master mechanic, finds electricity cheaper in cost of energy and of upkeep.

The quarry is comparatively dry, being drained by means of a 50-hp. Cameron centrifugal pump. A Gould pump, driven by a 7½-hp. motor, is used for supply purposes. An 80-hp. Blake steam pump is kept in reserve.

The fourteen stone-crushing plants of the France Stone Company and its six slag-crushing plants are located in Ohio, Michigan, Indiana, Pennsylvania and New York. The stone plants have a daily capacity of 25,000 tons and the slag plants 7,000 tons daily.

Tells Need of Stone Industry.

Editor Pit and Quarry:

The writer has been in the stone business for more than twenty-five years, handling building, dimension and crushed stone. It has been a continuous fight all these years to make even a meager percentage of profit, and I attribute this to the fact that quarrymen do not become acquainted with one another, do not visit and compare notes, etc., as they should do.

So it is to such papers as Pit and Quarry that we must look for the betterment of conditions and feeling among ourselves. Gravel and crushed stone men must play fair with one another; they must not be at one another's throats, for it is only they that will suffer.

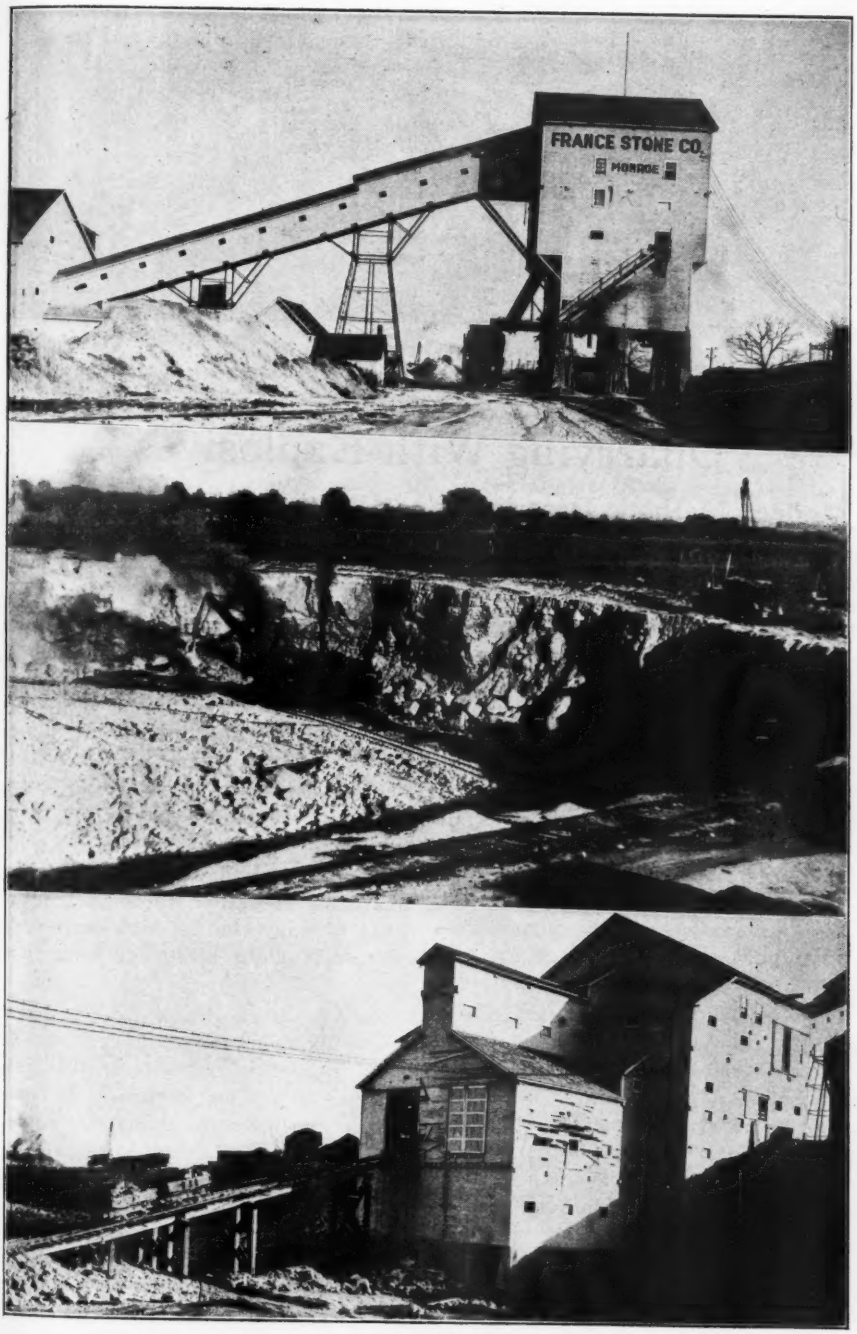
Your mission may well be, in part at least, to keep the cost of production before quarrymen literally and with all its contingencies, also the selling price in different parts of at least the West.

Respectfully,
E. P. McManus, Pres.,
McManus Quarries Co.,
Keokuk, Iowa.

An Exacting Animal.

"Do you think it is proper to use profanity to a mule?"

"So far as my own feelings are concerned," declared the skinner, "it is highly improper. But when you are trying to get along with as sensitive and exacting an animal as a mule you've simply got to humor him."



FRANCE STONE COMPANY'S PLANT AT MONROE, MICH.
1. Screen House (showing also belt housing from crushers). 2. Steam shovel at work.
3. Drawing stone to crushers. Note effect of "pop shots" on crusher house.

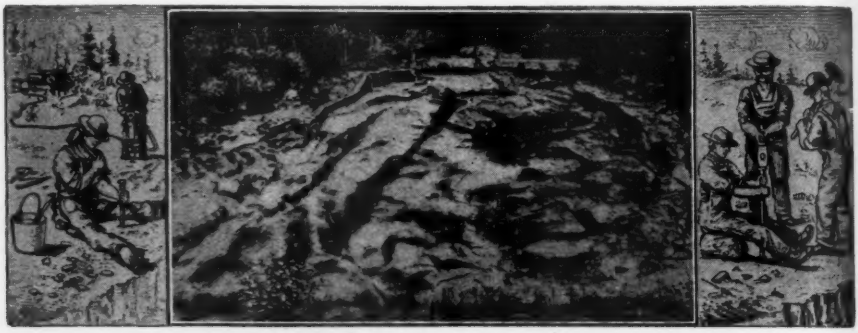


FIG. 1. A POORLY DEVELOPED QUARRY.
No system was used here in drilling and loading. The sketches at sides show hand and mechanical drills.

Quarrying With Explosives

Modern Methods Described and Illustrated—"Well Drills," Benching, Tunneling, Snakeholing, Etc.

ROCK is quarried for two purposes. Dimension stone, as it is known in the trade, may be described as stone taken out for building purposes, whether architectural or structural, in which the greatest proportion of the original strength of the stone is retained. This stone is shaped up and used for building of all kinds, foundations and trimming of buildings, as well as the main walls; bridges, masonry, piers, abutments, breakwaters, jetties and innumerable other purposes in which the original beauty of the stone and its original strength are retained.

The other class is where the rock is taken out without regard to its strength and beauty, where it is used after being crushed to about the size of stove coal for road construction, for making concrete, and mixed with sand and cement, and in "one man's" size stone, or stone about the size which one man can conveniently carry. This is the size generally desired when limestone is blasted for burning to make chemical lime, finishing lime and plaster.

In the first class of stone mentioned high explosives are not used at all, and explosives of any kind, like black powder, only sparingly, as the shock of the explosion is liable to start minute cracks and seams in the rock, which impair its strength.

In the second class we have a quarrying operation where vast quantities of many kinds of high explosives are used. These blasts are made in a number of ways.

Sometimes the holes are put down vertically from the top by means of what is known as "well drills" to a distance of 100 feet or more and from five to six inches in diameter. Sometimes tripod drills run by steam or compressed air are used which make holes generally 16 to 20 feet deep, as a maximum, and tapering from 2½ to 3 inches at the surface to perhaps 1¼ inches at the bottom of the hole. This same drilling may be used for putting in holes horizontally, or nearly

*Reproduced by permission from *Du Pont Magazine.*

so, at the point where the face of the quarry and the floor intersect. These holes are usually "sprung" or enlarged at the end so as to contain a much larger charge of explosives than would be possible if this springing operation were not done.

There is also the hand drill, which is similar to the tripod drill, except it is held in the man's hand, and, while operated by compressed air, can drill holes in any direction, but usually downward so that the weight of the drill aids in the force of the blow struck by the drill bit. These drills are not often used for holes over 8 or 10 feet deep and usually not more than an inch in diameter, but they are very convenient, as they consume almost no time in changing from one location to another, and very little time in changing from a shorter drill to a longer one. This hand drill, or hammer drill, as it is sometimes called, is also adapted for another kind of drilling, namely, a small tunnel, usually about 5 feet high and 3 feet wide, which is driven straight into the face of the quarry for a distance of 20 to 30 feet, at which point tunnels at right angles to the first are drilled in both directions. Sometimes the first tunnel is extended after the first cross cut is made and the second cross cut and sometimes a third is driven, and all of these tunnels loaded with large quantities of explosives and fired simultaneously, so that immense quantities of stone are brought down with one blast.

Figure 1 shows the beginning of a quarry before a definite working face has been developed. In this only the overlying earth has been taken off and possibly a few holes put in either by a one-man hand hammer and drill, or by some other equally primitive method, resulting in a considerable expense in drilling and no economy in explosives.

The face of a quarry is usually developed in such a way as to be at right angles to the tracks on which the stone is taken to the crusher, although, as we will see later, with the improved machinery on a larger scale, this track may be parallel to the face.

Figure 2 shows a typical benching

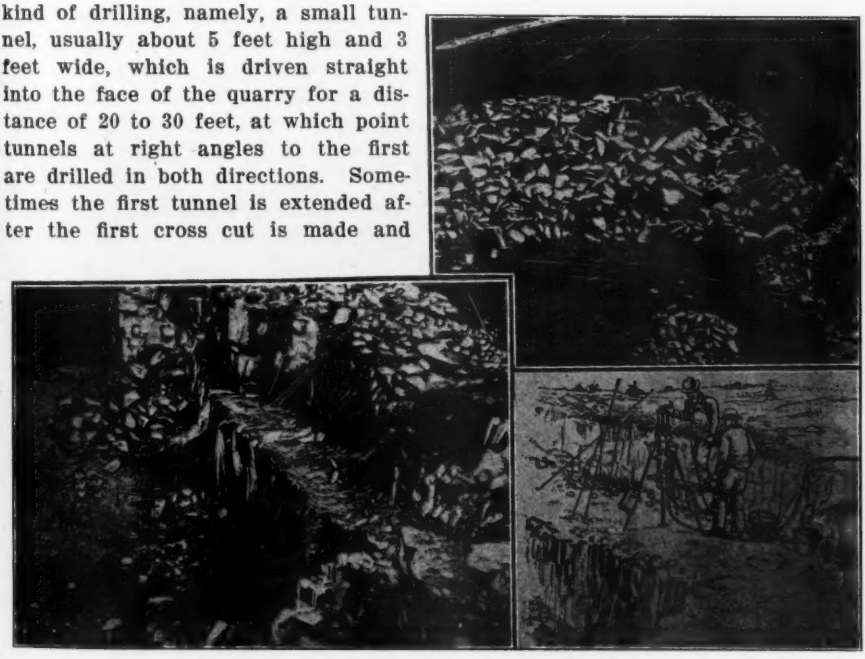


FIG. 2. SOME DETAILS OF THE BENCH METHOD OF QUARRYING.

operation in a quarry where a condition somewhat similar to an enormous stairway is developed, each step, as it were, being blasted out by a line of holes drilled either with a tripod drill or a power-hammer drill. This requires no expensive apparatus, is fairly economical with explosives, but has the disadvantage that only a rather limited amount of rock can be shot out at one time, and each bench must be carefully cleaned before the drilling operation can be started, otherwise too much valuable time is lost in moving the drill from one position to another. In this type of work the holes are usually drilled the entire height of the bench and from 8 to 12 feet back, the holes being spaced anywhere from 4 to 8 feet apart, depending on the nature of the material, the use to which it is put, and the explosives.

The benching method is only possible where the stratification of the rock admits of a nearly level surface on each bench. Where the stratification pitches either way more than a few degrees, or especially if it pitches downward toward the floor of the quarry, the bench method is usually replaced by the "snakeholing" method in which the tripod drill works on the quarry floor and drills holes nearly horizontal, pitching downward somewhat, directly into the face of the rock. After these have been drilled from 20 to 24 feet deep, two or three

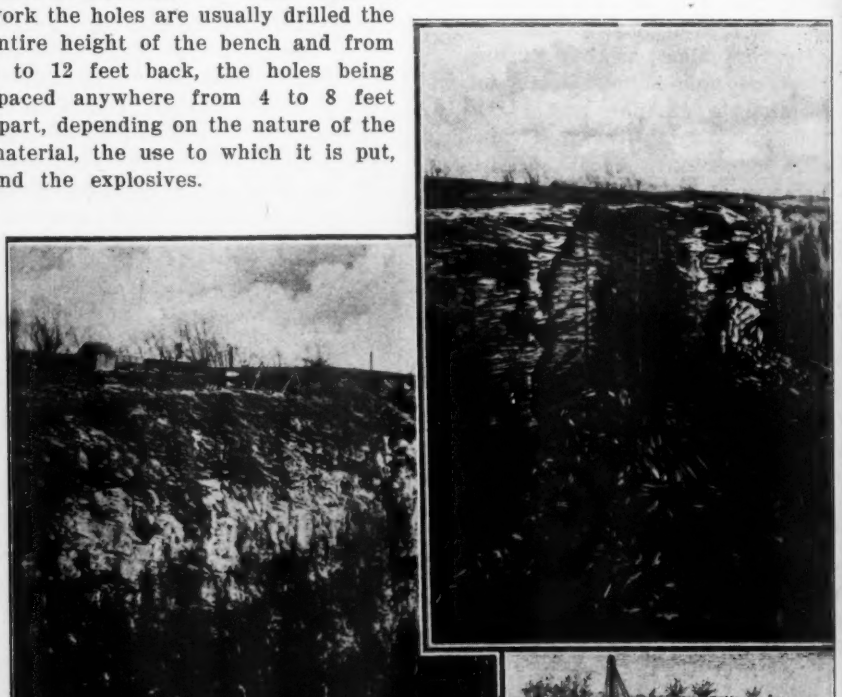


FIG. 3. FACE OF A QUARRY BEFORE AND AFTER A BLAST LOADED IN WELL-DRILLED HOLES.

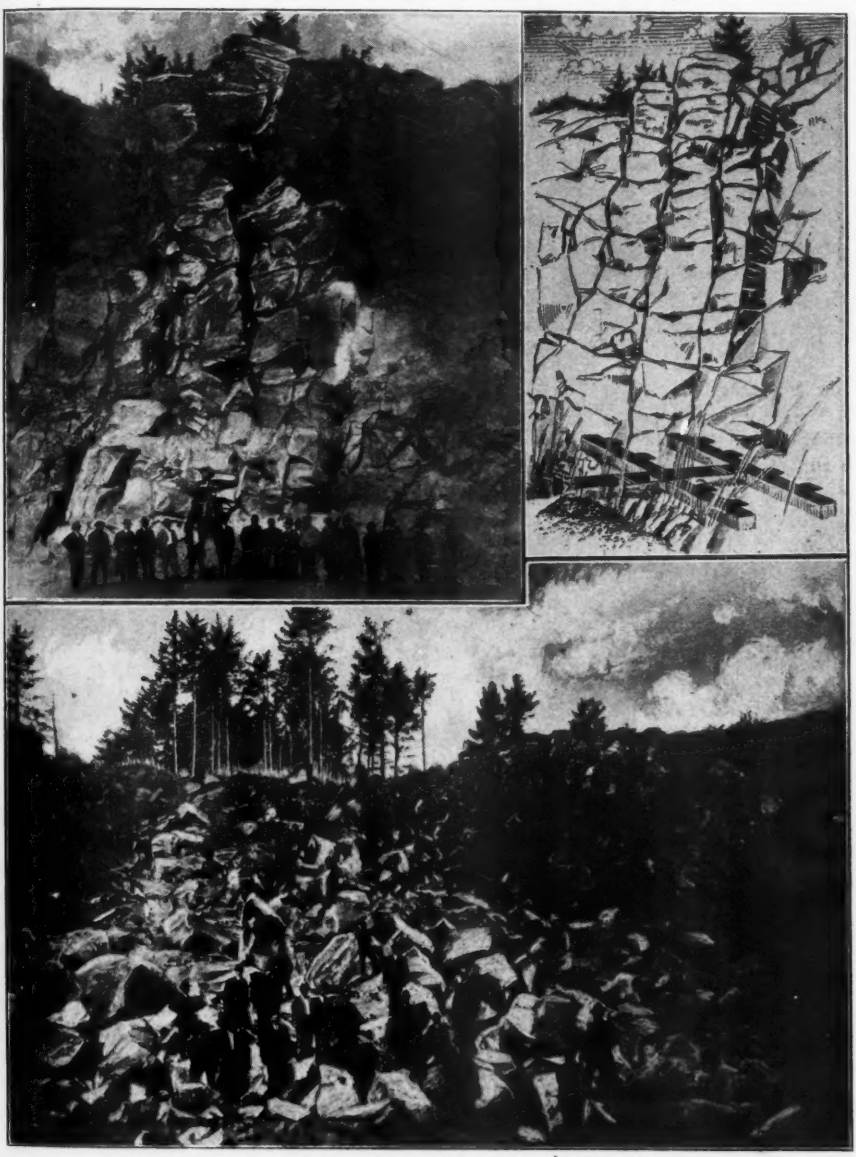


FIG. 4. LARGE QUARRY BEFORE AND AFTER A TUNNEL OR GOPHER HOLE SHOT.
The sketch shows the details of the tunnel.

cartridges of dynamite are exploded in the bottom of each hole. This is allowed to cool, and four or five cartridges are exploded, and successive increasing charges until the final pocket can be made to hold several hundred pounds of explosives. These, if the spacing is correct, will usually lift the entire face of the quarry up and throw it out on the floor. It is,

however, an operation requiring considerable care, skill and experience to be done successfully.

The most usual method of blasting large quarries at the present time is known as the well-drill method, shown in Figure 3. By means of the well-drill adapted to this purpose, holes are drilled in the rock the entire depth of the face of the quarry. They are usually 15 to 30 feet back from the face, this distance being known as the burden, and are spaced about 15 to 20 feet apart, 5⅝ inches in diameter being the most usual size. Any number of these holes can be fired by appropriate means at one time, but usually not more than 40 or 50 are attempted. By adapting the explosives used to the nature of the rock, it is possible to break it up in the size desired, and when properly spaced with the right burden, the broken rock is thrown out on the quarry floor without being scattered too far or without doing damage to buildings or other equipment unless some unseen weakness exists in the rock which cannot be guarded against. This is the most economical method of blasting rock for crushing at the present time, but requires a rather large and expensive equipment to handle it successfully.

One of the advantages of the well-drill system of blasting is that it admits of what is known as the "buffer" system of shooting. Figure 5 shows an example of this. It consists of throwing out a mass of broken rock in such a way that subsequent blasts can be fired before it is removed; that is, piling the debris up against the mass which has already been thrown out. In this way the rock from the first and second shots lies between the face and the steam shovel, so that the operation of the steam shovel is not suspended at any time. When this method is used, the steam shovel, and the cars which it fills, run on tracks parallel to the quarry face which is being blasted. The rock from each blast is simply piled up on top of and against previous blasts and is not thrown out on the quarry or on the tracks and equipment, so that the drilling and blasting can go on almost continuously and the tracks and equipment are never disturbed.

The limit in depth for well drills is from about 30 feet to 130 feet. Holes shallower than 30 feet are not economical by the well-drill method, and holes deeper than 130 feet are not often drilled, on account of the numerous difficulties which such a deep hole would entail.

Where slips and seams are known to exist in the face of a quarry, it is possible to guard against accidents sometimes by reducing the load of explosives at the weak point; this can be done by breaking the charge, as it is called, which is simply loading sand or rock dust into the hole at the weak point.

Not all quarries lend themselves to the economic use of the ,well-drill method. While limestone quarries which have a fairly soft rock to drill can be handled in this way no matter what the angle of stratification, harder rocks, such as syenite, granite, diabase, cannot be successfully worked by this method unless the stratification is horizontal, or nearly so, as the bits are liable to jam in the crevices where the rock seams form an acute angle with the line of the bore hole.

In some cases of trap rock, especially of a columnar formation, much more economical blasting is done by the snakeholing method, which blows out the bottom of the face, whereupon the overburden drops down and is shattered by its own weight.

A tunnel method is one which is

FIG. 5. A BUFFER SHOT.
Broken stone is left in place to prevent fragments flying from the next blast.

not used often in the eastern part of the United States, but quite frequently on the Pacific Coast. It is one which involves the drilling and blasting of a small tunnel by means of air-hammer drills and the loading of large charges of explosives in the ends and at intermittent points in the cross cuts of the tunnel. This method also depends on the broken-up stratification of the rock to fall down of its own weight when the tunnel charge throws out the underburden and allows the top or overburden to fall down of its own weight. In this method relatively slow-acting and weak explosives, either blasting powder or powder of the Dupont R. R. P. type, are used with one or more 50-pound cases of dynamite, preferably a quick-acting dynamite, as a priming or igniting charge. The "R. R. P." is usually stacked in the tunnels in the paper bags in which it is packed, and the cases of dynamite in the center of each charge of "R. R. P."

When black blasting powder is used in tunnel charges, it is sometimes transferred into bags of burlap before being loaded in the tunnel, but equally good results are obtained by stacking up the powder in its original kegs, with the priming charge of several cases of straight dynamite in the center of the stack. The explosion of this ruptures the kegs, so that the black powder is exploded just as efficiently as if it were in bags or in bulk, besides giving the protection against the moisture which the steel

kegs afford. These unit charges may be several thousand pounds of explosives, and are separated from each other in the cross cut by filling materials, such as sand, rock, and sometimes timbers laid into the sides of the tunnel. These, of course, are all fired electrically. A whole carload or more of explosives may be used in one shot, and when it is successful, a considerable saving is effected over any other method.

The successful development of a modern quarry demands a close study, not only of the purpose for which the rock is used, but also the nature of the rock, its stratifications, slips, seams and weaknesses, before the type of drilling best adapted can be decided upon. After this, care is necessary to determine how the charge of explosive can be best placed to bring down the maximum amount of material, and the best explosive for the purpose must be selected out of several hundred kinds, brands and grades on the market.

Why Advertise Now?

Discontinuance, or even sharp curtailment, of advertising because of temporary war conditions, would seem to imperil the most valuable asset that any business has, namely, its good will. No more faulty logic can be found than that which would impel a manufacturer to cease building for the future by means of advertising, simply because the output of his factory is for the time being restricted, or because diversion of his facilities to war work has operated to withhold his goods from accustomed markets. In modern business there can be no sufficient unto-the-day policy.

W. B. COLVER,
Chairman Federal Trade Com.

DON'T miss sending every copy. PIT AND QUARRY is greatly appreciated.—Goodwin-Gallagher Sand & Gravel Corp., New York City, N. Y.

The Toll of Carelessness.

C. W. Price, field secretary of the National Safety Council, in an address made in St. Louis during Safety Week, predicted that the United States will lose more men by industrial and street car accidents in 1918 than it will lose by war. "During 1917," he said, "80,000 persons lost their lives in accidents in the United States, and at least 50,000 of these lives might have been saved."

What Is Slag?

Frequently the question is asked, "What is slag?" When a ton of iron ore goes into the melting-pot a ton of stone goes in with it. The mass is melted and the molten stone grabs and holds the impurities in the ore. The real iron runs off in pig-iron form and molds. The residue or waste cools and is called "slag." This waste material is broken in crushers as ordinary stone is broken. It is then used to construct roads and in concrete work. It was once thrown away as waste-product.

Compensation

"Pat," asked Mike, looking up from the newspaper, "what does compensation mean?"

"Why, yer see, it's this way, Mike, me b'ye," answered Pat, "whin one part of ye is lacking another part becomes better than ordinary and makes up, do yer see?"

Mike wrinkled his brow and studied the problem. Finally he said: "I've noticed that whin a man's right leg is shorter than the other the left leg is always longer. Is that what ye mean?"—Boston Journal.

No Trimmings.

Tom Callahan, holding down a job on the railroad section, was ordered to go along the line and look for washouts.

"And don't be as long-winded in your reports as you have been," said the superintendent. "Just report the condition of the roadbed as you find it, and don't use a lot of needless words that are not to the point. Write a business letter, not a love-letter."

Tom proceeded on his tour of inspection. When he reached the river he wrote this:

"Sir: Where the railroad was the river is."

Preparing Roadways So As to Eliminate Ruts

SOME CITIES have tried the plan of filling in ruts with a top dressing and then applying a binder, but this has not brought about satisfactory results, for the reason that the binder did not permanently hold the loose top dressing to the solid earth. It soon cracks and either is blown away or is kicked up by horses' hoofs. It is agreed by all that the entire surface of the roadway should be loosened and leveled off.

How Top is Dressed

Various kinds of top dressings are used, such as trap rock, red shale and gravel. Many New Jersey roads which have given satisfaction have been top dressed with trap rock or red shale and a binder of flutrin used. A bottom course is laid about 1½ to 2 inches thick, 1¼-inch stone being used. This is then rolled thoroughly with a 10-ton roller.

Another layer of 1¼-inch stone is spread on this and is also thoroughly rolled. A ½-inch layer of screenings is then scattered on top, wetted with glutrin diluted with ten times its volume of water, and again subjected to a thorough rolling. The road is then allowed to dry out for a short time before the final surface treatment.

Beginning with a very thin mixture, perhaps one part glutrin to ten of water, this preparation is sprinkled over the surface, using an ordinary sprinkling cart. As fast as it is absorbed, more is applied, until the road has taken up about one-half gallon of glutrin per square yard.

The last application is mixed in the proportion of one part glutrin to three or four of water. The mixture is applied to the center of the road and by absorption and capillary attraction works its way downwards and sideways. The cost of this treatment, road officials claim, is about the same as that of using oil. When properly applied, it produces a hard, waterproof surface. Glutrin has also been used by cities in Tennessee and Indiana.

Where Gravel is Used

Experts call attention to the necessity of care being used to balance the mixture when run-of-bank gravel is used. The best practice in making a bituminous concrete mixture requires that certain proportions of the various sizes of aggregate should be used in each batch of mixture.

Attention has been called by experts to bituminous gravel pavements on Long Island. In some of these the mixture has been out of balance in two ways—either too dry or too rich. A pavement at Amityville, N. Y., was laid without a squeegee coat, hence defects of dryness were more apparent than they would otherwise be. There are a few holes in it which have resulted from dry spots in the mixture.

At Babylon there is a bituminous gravel pavement where the mixture is generally too rich. This results in the finest material and the bitumen rising to the surface, and horses' hoofs and wagon wheels make deep impressions in and even tear up the surface. Wagon wheels are also gummed up with bitumen material after running over the pavement.

The kind of material to be used—that is, the kind of binder and top dressing—depends a great deal upon the character of the soil of the roadway.

Pit and Quarry

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After the War.

HOW prosperous will we, as a nation, be after the war? This question has been a theme of much speculation, and the consensus of what has been said and written on this subject seems to be that in the days to come the American people will be the merchant princes of the world and prosperous as never before. We have long ceased to be a debtor nation; the wheel has turned so that now we are the world's bankers. We have just begun to realize our tremendous national resources, and when peace comes we shall know as we have not hitherto known how to use them. Then, too, we shall have for peaceful commerce the use of a great fleet of cargo vessels which but for the stern compulsion of war we might not have had for a century to come. Add to this the good will of all the world, and why should we not be prosperous? This much as concerns the nation. For that we need not fear. But what about the particular and special industries represented by PIT AND QUARRY? These have suffered somewhat under governmental restrictions, which in some cases may have seemed harsh, but which under war conditions were inevitable. For these there will be sure and speedy recompense. When peace is declared there will ensue in the United States an era of civil and business mobilization unprecedented in history. It will be a period of construction and highway building. Many of our growing cities are underbuilt—housing is required for domiciles and for industry. Our highways are inadequate—new and better arteries for inter-community and transcontinental communication are needed and will surely be built. This means that all the industries concerned with mineral aggregates will be prosperous. It means also that we must prepare now for this coming time of activity and prosperity. While we must continue to plan every day what each business and each individual can do to hasten a victory already assured, we must also plan to help fortify America for the gigantic tasks awaiting all its industries.

Get Together? Why Not?

THERE should be only one answer to the question as to whether there should be a joint meeting of the national associations of the gravel and stone industries. There are scores of reasons in the affirmative. For the negative there is only one, and that is past differences which are rapidly being forgotten. These will appear as foolish trifles when the advantages to be gained by intelligent coöperation—competitive coöperation if you wish, or coöperative competition if you pre-

fer—are once realized. Also, let it not be forgotten that, through the War Service Committee on Mineral Aggregates, Uncle Sam has joined these two great industries in the bonds of patriotism. And what Uncle Sam has joined together let no man put asunder.

Our Highways.

THE important part that the highways are playing in the winning of the war and the general development of the country is being more and more brought out each day. Secretary Lane, in a recent address, showed the effect of highway development during the early period of the French nation and also outlined what effect we can expect it to have on the general development of this country on the return of the soldiers from the other side. He said:

"I can conceive of a United States that will be as rich per acre as France; in which the people will be divided into small communities, industrial communities as well as agricultural; for every one of these little places ought to have its own creamery, its own cannery. The farmer is the poorest man in the world to develop any kind of coöperative scheme. He needs assistance and is always hampered by the lack of capital. But now is our chance to see what can be done; to show it in the building of ideal communities; communities that have good houses, that have good sanitation, that are on good land where there is somebody who can direct them as to what should be planted and what should be avoided; communities which may be connected up with the world by highways, by developing rivers and by railroads."

It is the duty of all who are interested in highway improvement to look ahead toward these conditions which are sure to come as a recompense for the hardships of war, and to be ready to meet them, so that road construction can advance on the proper lines, viz.: National highways, state highways and county highways.

BANKERS throughout the nation are directing the attention of their patrons to the imperative need for conservation of credit and to the direction of its use into channels of essential production. Every available dollar will be needed during the forthcoming year in producing the things that are necessary to maintain our armies, to supply our allies and for the health and efficiency of our own people. Wasting credit or failing to apply every dollar in such way as will make it yield the maximum of service is as detrimental to the interests of this country as is the destruction of food. The trade acceptance will conserve credit and make a like amount of capital do greater service. It is adaptable to practically every line of industry.

ONE of the most important conventions of 1918 is that scheduled for December 4 and 5 in Chicago—the joint meeting of the American Association of State Highway Officials and the Highway Industries Association. Make your plans now to attend.

THERE is no question that the old Roman highways and the roads Napoleon built have saved France in this war. Guns, supplies, ammunition, men, everything is dependent on the automobile.—Stanley Field.

A COUNTRY worth fighting for is a country worth saving for. Buy Thrift Stamps.

Wet Sand is Lighter Than Dry Sand

By R. W. Scheber

IN THE course of recent investigations in concrete-mixing a fact came to light which may be known to but few quarrymen and pit operators. It is that wet sand is actually lighter than dry sand. This may seem paradoxical, but it is explained by the fact that the water spreads the grains of the sand, or, in other words, "bulks it up."

The method of determining the comparative weights was this: A quantity of dry sand was poured into a vessel, filling it to a certain mark. It weighed 63¾ ounces. It was then removed from the graduated vessel and water added so that it had about the temper of material coming from a washer; that is, the moisture was all held by the sand grains and would not have dripped if the moist sand had been placed in a sieve.

This amount of wetting required 3¾ ounces of water, about 6 per cent by weight of the quantity of sand. The sand after wetting was again poured into the graduated vessel, but could not all be contained therein without tamping, although the contents were shaken down. Seven ounces of the wet sand were left after filling the vessel to the mark. The moist sand that filled the vessel weighed 60½ ounces as compared with 63¾ ounces of dry material.

So it develops that 6 per cent by weight of water adds 11 per cent of volume to the sand. This fact has a bearing on laboratory tests of sand or cement, because if in the laboratory we use dry sand and proportion it to the cement by volume, we are actually using 11 per cent more sand than in field work, where wet sand is the rule.

This does not mean that a quantity of sand weighed dry will not weigh more after it has been moistened. Water "bulks up" the sand if it is stirred about; it would not do so if sand were wetted down while held in the vessel; so that it is a question of when the sand gets the moisture. Also in buying sand by weight one gets less material in wet sand than in the dry, because, of course, the water adds to the weight. In buying by measurement one also gets less material in wet sand than in dry, because one yard of dry sand will produce 1.11 yards of wet sand. Still the interesting fact remains that wet sand is 5 per cent lighter than dry sand.

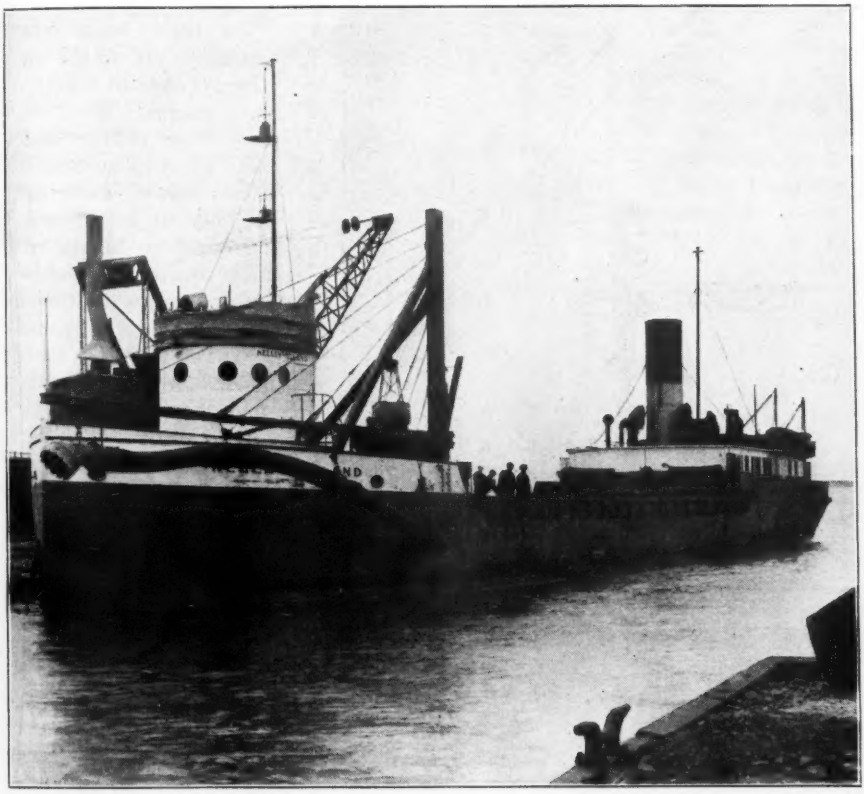
Sulphur from Gypsum.

As an example of the shifts to which Germany has been put to obtain raw materials a London paper cites a statement made by Dr. Bosch, of the Badische Ainilin-und Sodafabrik, at a recent meeting of the Bunsen Gesellschaft. Large deposits of gypsum, he said, occur in the muschelkalk (shell marl) of the Nectar in Würtemberg, and this gypsum is used as raw material for sulphur compounds. The gypsum is slightly soluble in water; the solution is precipitated with ammonium carbonate, that is to say, ammonia and smoke gas are bubbled through it, causing calcium carbonate to be precipitated and ammonium sulphate gained. As the solution is already diluted, little water is used in washing the sulphate out of the precipitate, and special filters have been devised for this purpose. The crusts of calcium carbonate forming in the filters gave trouble, but this has been overcome.

PIT AND QUARRY is filled with good points that are right to the point, and every article is of benefit to the producers of sand, gravel and crushed stone. —Standard Sand Co., Sioux City, Iowa.

Typical Lake Erie Operations

Methods Employed by Two of Ohio's Successful and Prosperous Sand and Gravel Concerns.*

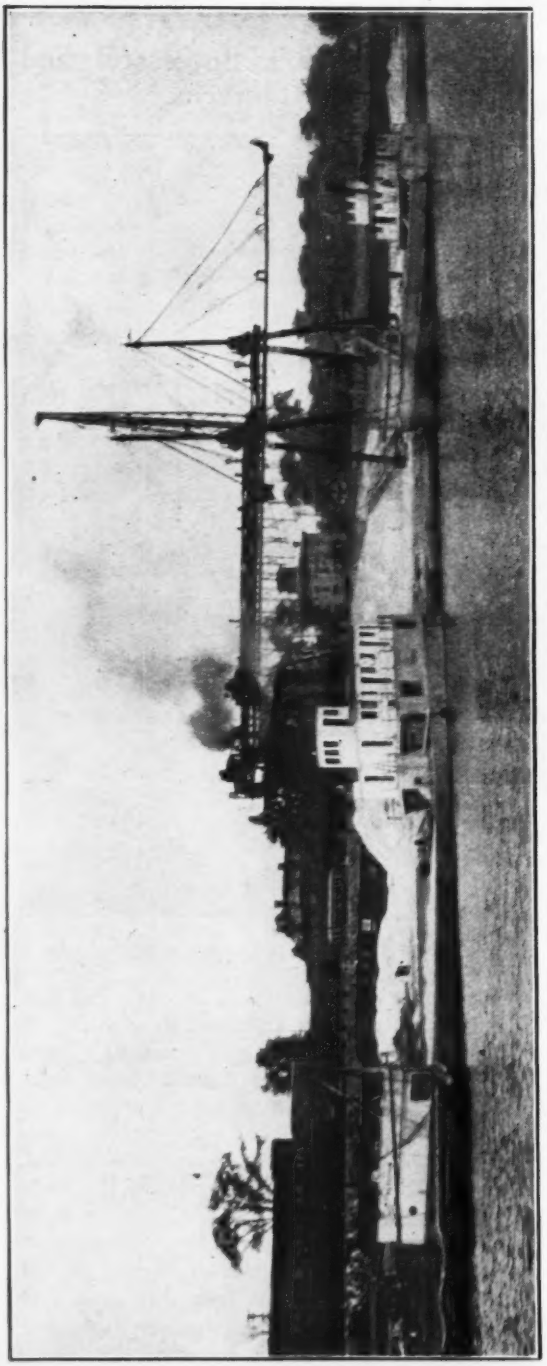


Steamboat Dredge of the Kelley Island Lime and Transport Company.

THE Kelley Island Lime and Transport Company has very large and diversified interests at Sandusky, Cleveland and other Lake Erie points. It has been in the lake sand business since 1906. At the present time it is operating four sand dredges and has a daily capacity of sixty cars of screened lake sand. The company does not produce screened gravel; it does, however, produce a "conglomerate" that will pass through two-inch and contains a proportion of sand.

The Kelley Island Company's boats pump from two different sand beds. One is located within three miles of Sandusky, and the other on the Canadian shores, about twenty miles distant. The sand is pumped aboard the boats with centrifugal pumps. As the material goes onto the boats it is run over screens which separate the gravel and other substances from the sand and permit it to be washed overboard

*Courtesy of the Ohio Sand and Gravel Bulletin.



Storing and Loading Sand and Gravel for Shipment by the DoVille Lake Sand and Gravel Company.

through the sluice-ways. The boats operate under their own power and regular daily trips are made to both pumping grounds.

On these boats are installed the following direct-connected centrifugal pumps: Two 10-inch, one 12-inch and one 1-inch. The largest boat has a carrying capacity of 1,250 tons. The average length of time required to pump such a cargo is three hours. It is interesting to know, however, that under favorable conditions they have pumped a full cargo in one and a half hours' time.

The storage dock is 650 feet long and has a capacity of 30,000 tons. The dock is equipped with two clam-shell derricks and boats are unloaded promptly upon arrival alongside the dock, either day or night.

The photograph reproduced on the preceding page shows one of the company's sand dredges. It will be noted that this is of regular steamboat type, with the necessary equipment installed aboard for the pumping of sand and gravel.

The Kelley Island Sand and Gravel Company has been very successful in the Lake Erie district and is held in high esteem by other producers.

The DoVille Lake Sand and Gravel Company

In 1882 Egbert DoVille, father of R. E. DoVille, the present president and manager of the DoVille Lake Sand and Gravel Company of Toledo, Ohio, conceived the idea of producing lake sand and gravel for the Toledo market by means of suction dredges. Prior to that time all sand produced was obtained from dipper dredges and delivered on docks, where it was necessary to screen the material, and then it was impossible to remove any small foreign substance that the material might contain. The new method eliminated all of this, as the sand obtained with suction dredges is thoroughly washed and screened to required size as it comes aboard the boats and before it falls on the deck in the receiving pockets. It is therefore ready to use for the different purposes for which sand is required.

In the early days of the business sand was unloaded from the boats onto the docks, and also into box and gondola cars for shipment, by men with wheelbarrows. This was a very expensive way of handling and consumed much time, and it was soon found advisable to install revolving derricks with clamshell buckets, which are now being used at nearly all lake front docks for handling this class of material.

Twenty-five years ago R. E. DoVille became associated with his father in the business, which has since enjoyed a steady growth. In order to meet the increasing demands for sand, it became necessary to add to the producing capacity, so in 1905 the company built the steamer "R. R. DoVille," the first steel sand boat to be constructed on the Great Lakes.

The company now produces sand from the Maumee River, from Lake Erie and from Fish Point, Pelee Island, Ont., for the Toledo market, and from Lake St. Clair for the Detroit market. While most of the sand produced is shipped at once, the company has facilities for storing a large quantity of sand for shipment after the close of navigation.

The business up to August 1, 1907, was conducted by a partnership, but at that time it was incorporated under the laws of Ohio. Its present officers are Raymond E. DoVille, president and manager; Albert D. Weaver, vice-president, and Samuel P. Gisel, secretary and treasurer. This concern is one of the principal producers at Toledo and is recognized as a live and up-to-date concern.

The accompanying cut shows the company's steamers "Commerce" and "R. E. DoVille" waiting to be unloaded.

Everything Ready—Except the Roads.

The stage is being set for American leadership throughout the world.

Great cities, pulsing with energy and linked together with transcontinental lines of railway, are, on one hand, concentrating a war-winning power behind our forces at the front.

Our Cities Are Ready.

Back and away from these cities, on the other hand, lies the country, cut into more than six million food-producing farms.

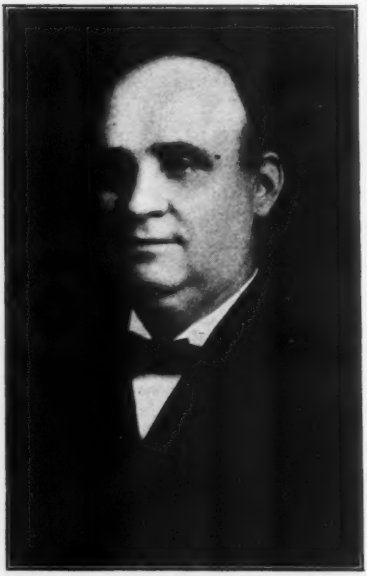
Our Farms Also Are Ready.

Between farm and city there lie more than two million miles of highway filled with mud and dust, ruts and holes, obstructing the passage of produce at a loss of more than $300,000,000 a year, to say nothing of the loss incurred in man-power and in inter-community traffic.

Our Roads Are Not Ready.

Sooner or later they must be improved to complete our transportation system, and they must be improved with a view to meeting the demands of the traffic that is here—and of the probable greater traffic that is to come.

ASSOCIATION ACTIVITIES



JAMES G. SHAW
Chairman of the War Service Committee

Join Your Association.

Hereafter the crushed stone and sand and gravel industries in their relations to the Government will be represented by their War Service Committee, known officially as the Committee on Mineral Aggregates of the War Industries Board. The industries are being mobilized. Every producer will want to do his part. Every producer should become a part of his national organization. Coöperation has already done wonders—the work must go on.

If you haven't joined, ask for particulars. Here are the organizations:

The National Crushed Stone Association, A. P. Sandles, Sec'y, 405 Hartman Bldg., Columbus, O.

The National Association of Sand and Gravel Producers, E. Guy Sutton, Sec'y, Majestic Building, Indianapolis, Ind.

The National Agricultural Limestone Association, 406 Hartman Building, Columbus, O.

National Slag Association, H. J. Love, Sec'y, Leader-News Building, Cleveland.

Southern Limestone Association.

LIMESTONE producers representing the States of Tennessee, North and South Carolina, Georgia, Florida and Alabama are now permanently organized under the name Southern Agricultural Limestone Association, with the following officers:

President—Sam J. Buguo, Planters' Limestone Co., Grovania, Ga.
Vice-President—Wade H. Davis, Empire Cement and Limestone Co., Atlanta, Ga.
Secretary and Treasurer—L. J. Backus, Ladd Lime and Stone Co., Atlanta, Ga.

The initial meeting was held at Atlanta, and regular meetings will hereafter be held annually, although the executive committee has the power to act at any time in case of necessity for immediate action. The purpose of the association, as stated in the constitution, is "to further the interests of limestone manufacturers within the district and to promote in every legitimate way the use of ground limestone."

Facts and figures produced at the Atlanta meeting augur well for the prosperity and usefulness of this new organization. In the territory which it covers a large percentage of the material produced is shipped to fertilizer manufacturers, who use it as a dryer, conditioner and filler. The State of Georgia alone, it was said, uses about one-fifth of all the fertilizer produced in the United States. The crops grown largely in the section, such as cowpeas, soy beans, velvet beans, peanuts, etc., are necessary as soil builders and many of them are oil producers. All are specially benefited by limestone. Cotton, too, it has been

shown by recent experiments, is helped wonderfully by limestone, which hastens that early development necessary to frustrate the ever impending danger of the boll weevil.

Michigan S. & G. Association.

The executive committee of the Michigan Sand and Gravel Producers' Association held its first meeting in Saginaw on the afternoon of October 3. Messrs. Bradley, Baker, Smith, Porter and President Ray were present, and several hours were spent in informal discussion and in planning the work to be undertaken by the association in the interest of producers.

Guy C. Baker outlined the plans on which the Ohio Association was now working and also presented some ideas which had been suggested by Mr. Sutton of the National Association.

An interesting talk on the making of freight rates was given by Mr. Bradley. In the discussion following it was generally agreed that the raising of rates by the railroad administration had been very severe on the business, and that they should be rearranged on a more equitable basis. This, of course, would take time, as a necessary preliminary would be a thorough investigation of local conditions.

The meeting informally approved of the National Association taking over the magazine now issued by the Ohio Association, also the proposed joint meeting in the near future of the officers of the Ohio, Indiana, Illinois and Michigan Associations.

John S. Porter was engaged temporarily as acting executive secretary, and it was agreed to assess the membership one mill per ton on 1918 business after September 1.

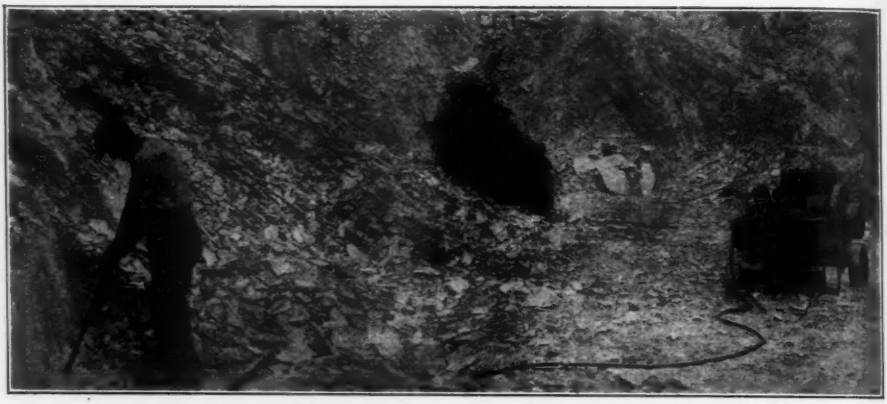
WE WISH to say that PIT AND QUARRY is put up in a very instructive and attractive form.—The Portage Silica Co., Youngstown, O.

American Manganese.

Deposits of manganese and manganiferous ores in many parts of the United States have been examined during the last two years by geologists of the United States Geological Survey, Department of the Interior. This is essential work, because the limitation of shipping facilities has reduced the imports of manganese ore from other sources than the West Indies and Central America in 1918 nearly one-third below those of 1917 and there is a prospect that they will be still further reduced in 1919. The importation of the iron-manganese alloy ferromanganese has decreased in much greater proportion and probably will soon be stopped altogether. To offset these decreases the Geological Survey has assisted in stimulating the domestic and the near-by foreign production by examining the manganese deposits in this country and in the West Indies with the view of determining the availability of the ore. The producers of domestic manganese ore have responded actively to the call made on them and have increased their production from 27,000 tons in 1916 to 116,000 tons in 1917. It now appears that the production of ore in 1918 will be 185,000 tons.

Manganese is used in various ways. Metallic manganese in the form of ferromanganese is alloyed with steel to make manganese steel, and manganese dioxide is used in the manufacture of dry batteries, in glassmaking, and in the chemical industries. Manganese, however, is used principally in making all Bessemer and open-hearth steels, in which it is incorporated in the form of iron-manganese alloys, which serve as deoxidizers and purifiers of the molten metal. More than 95 per cent of all the manganese consumed in this country is used for this purpose.

MEN AND MACHINERY



Typical Scene in Pennsylvania Quarry.

Cut Out the Extra Costs.

One of the editors of this journal recently stood in a quarry and watched three men loading crushed stone with shovels into carts, hauling it to a platform and dumping the stone into a car for shipment. The stone had been crushed when cars or orders were scarce and placed in a stock pile. This had already entailed an extra cost over loading a car directly from the bins. While the loading of the car was going on a two-ton truck came to the stock pile to be loaded. Two extra men were called and the truck was loaded in about ten minutes. The men worked hard, but this rehandling was costing about twenty cents per ton for loading, while that hauled in the carts cost over twenty-five cents to place it in the car. This would figure as a good profit on a ton of stone.

At one time such a cost was necessary, but there are so many devices for re-handling crushed stone, gravel and sand that a quarry owner cannot afford to be without some type of re-handling machine.

Conserving Manpower

The enormous drain of the war on the industrial manpower of the nation has made the problem of labor conservation a vital issue. The press is full of sermons every day about the sinfulness of food waste, but labor waste somehow has not been given the attention it deserves. Broken-down equipment and old-fashioned hand operation, in these days of universal economic stress, are criminal, when every unit of labor is needed for national defense. In the stone industry, for example, there are still thousands of obsolete steam drills on the job and tens of thousands of holes are still being drilled by hand, despite the fact that modern equipment to take the place of primitive methods can be bought at prices so low as to repay

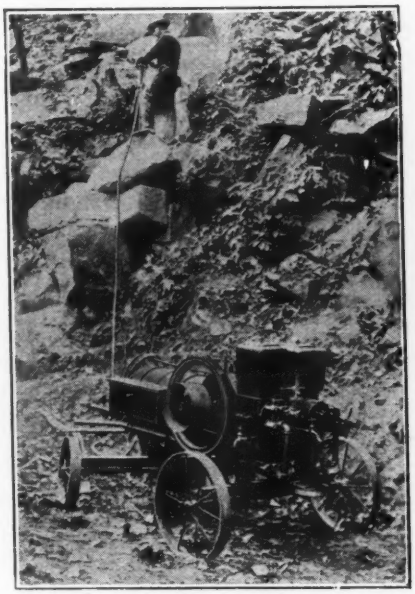
the investment in a few months' time at present rates of wages for even common labor. The illustrations herewith, reproduced by courtesy of Chris D. Schramm & Co., Inc., show some of the uses of that firm's line of portable air compressors in the quarry as well as for road work. A complete outfit of this kind, the manufacturers say, costs less than $500, itemized as follows:

No. 2 compressor	$375.00
Special rock drill	60.00
50 ft. length of hose	12.50
1 leader hose	3.50
1 set of dollies for dressing bits.	7.50
Assortment of rock drill bits	23.78
Total	$482.28

This equipment in almost every instance will produce ten times as many feet of holes as the old hand method. The operating expense, aside from the wage of the operator, is about four gallons of gasoline and one pint of oil. On certain kinds of work one week's use will pay the cost of the entire equipment.

Crushing Coal Without Grinding.

Bulletin No. 10 of the Brainard Pulverizer Co. (Old Colony Building, Chicago) should prove of special interest just now when the question of fuel is of such tremendous moment industrially as well as economically. The Brainard impact crusher, the workings of which are here clearly shown in a colored diagram, differs from other hammer mills or "pulverizers" in many vital particulars. The hammers, which, for the style illustrated in the bulletin, weigh 100 pounds each, and which revolve at a speed of 400 to 600 r.p.m., come in contact with the coal on the *up*stroke, thus avoiding all grinding and producing, therefore, less objectionable "fines" than by any other method of coal-crushing. This also makes for greater uniformity of product, besides requiring less power.



Portable Air Compressor used in splitting up boulders.

Another unique feature is that the impact of the hammers striking the coal from the under side drives it up into the impact chamber, whence it is returned to the hammers by gravity and the operation repeated. The succeeding blows, however, striking the coal while in suspension, are lighter in proportion as the coal is reduced in size. Many varied sizes are made by changing the speed, reducing the number of hammers used, or changing the position of the sizing block.

Conserving Wire Rope.

Very often a small initial expense in connection with the conditions under which wire rope is to work will eventually result in large savings.

One very vital factor is the size of drums and sheaves, and the larger they are in diameter the longer your rope will last, other conditions being equal.

The grooves of drums and sheaves should be smooth and of sufficient size so that the rope fits easily into them

without binding on the sides. When the grooves become scored, they should be turned to eliminate the corrugations.

See that all rollers, sheaves and drums are in line and in good condition. One bad roller or sheave is like the weak link in a chain—it lessens the efficiency of the entire equipment.

Avoid, if possible, reversed bends and the overlapping of wire rope on drums.

When a rope is to be cut, great care should be taken to securely and properly serve or bind the rope on each side of the place to be cut so as to prevent one strand from working back, and, as a consequence, not receiving its share of the stress. This condition causes what is known as "high strand." These same instructions apply when a socket is to be attached to rope.

Wire rope should be lubricated both when in use and when idle. Lubrication does not mean simply to cover the rope with any kind of oil or grease. A proper lubricant will not only protect the outer wires against action of moisture, water, acids, etc., but will also work in between the wires and the hemp center, protecting them as well as oiling the points of friction. —*Leschen's Hercules.*

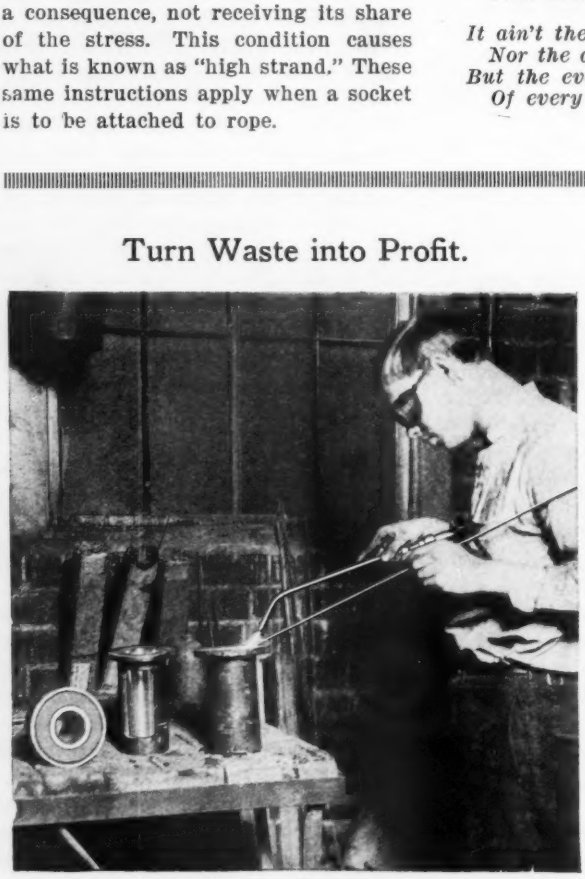
Line Up!

It ain't the guns, nor armament,
Nor funds that they can pay,
But the close coöperation
That makes them win the day.

It ain't the individuals
Nor the army as a whole,
But the everlastin' team work
Of every bloomin' soul.

—*R. K.*

Turn Waste into Profit.



Repairing a Bronze Bearing.

Worn bronze bearings make expensive "junk." By the addition of bronze metal by the Prest-O-Lite Process, flanges are restored and worn places built up, giving the bearings new life at remarkably low cost. The possibilities for immediately reclaiming broken and worn equipment not only make possible enormous savings over the cost of new parts, but make it unnecessary, in many instances, to carry a costly stock of reserve parts. The illustration shows one of many cases where the scrap pile is kept down at a great profit.

Conservation of Coal

FROM a patriotic as well as a practical business standpoint it is the duty of every American citizen to put forth every effort to economize coal. It is a duty to ourselves, to our business, to our country.

It is a well established fact that from 30 to 40 per cent of the fuel burned in the United States is wasted. Looking in any direction one will see, pouring from the chimneys and smokestacks, clouds of smoke which represent loss in unconsumed carbon. This should not be.

The secret of complete combustion in any furnace is to expose every atom of coal to the proper amount of oxygen. To accomplish this it is necessary to pulverize the coal very fine and blow it into the furnace with just the proper amount of air. That and that only, solves the combustion problem. And not only will everything combustible in the coal be consumed with no loss in ash, but it will also solve the clinker and smoke problems. Flexibility of operation will permit of a quick adjustment to suit any condition under overloading; or, in the case of accident, there is instant shutting-off of the fuel supply. It is possible to burn coal of almost any analysis in pulverized form.

The low cost of a coal-pulverizing installation in power plants, as compared with other means of firing coal in large installations of 4,000 hp. and upward, makes it a feature to be taken into consideration. As compared with producer-gas in an open-hearth furnace, there is a saving of approximately 30 per cent in fuel. Pulverized coal can be prepared for sixty cents and even as low as twenty cents per ton. This cost is dependent strictly upon the quantity of coal handled and the moisture contents in the coal as received.

The equipment for preparing pulverized coal for the furnace should be preceded by a magnetic separator to remove foreign metal, such as scrap iron and particles of steel. The pulverizing equipment itself should be as follows:

A crusher that will reduce the coal to a uniform size ranging from ¼ in. to 1¼ in., making the least possible amount of fines. Great care should be taken in the choice of the coal crusher. The feed opening should be large enough to take mine-run coal, which would be approximately a 24 by 24 in. opening. It should not have the grinding action or the coal-cutting principle, but should either crush by direct pressure or by impact while the coal is in suspension.

A dryer should be of such construction that the direct heat from the firebox can not come in direct contact with the coal, and should the products of combustion pass through the coal, they must be sufficiently cooled down to prevent ignition. There are a number of these dryers built that will reduce the coal to less than 1 per cent moisture, and this is essential for the after-treatment and for successful feed to the furnaces.

The final operation is the pulverizing process. There are a great variety of pulverizers that will do this work. Care should be taken to choose a machine with the least possible number of bearings, and all bearings should either be protected to keep out the dust, or, better still, located entirely outside of the coal-pulverizing chamber. The machine that seems to be taking the lead at the present time in coal-pulverizing plants is the well known Fuller Mill, built by the Fuller-Lehigh Company, among its advantages being simplicity of construction, low upkeep and high efficiency. It makes a finished product in one operation, reducing the coal from 1¼ in. to a product 85 per cent of which will pass through a 200-mesh screen.

It is essential in this machine, as in all other machines for fine pulverizing, to eliminate as much of the very fine material as possible from the feed. The best way to accomplish this is to avoid making it in the preliminary crushing. A storage bin of small capacity should follow the pulverizer. The pulverizer coal can be distributed through the plant either by screw conveyors, air pressure or gravity. The nozzles for delivering the coal to the furnaces are of various types. In most cases greatest economy is gained where the nozzles blow the fuel into the furnace in a wide spray, allowing each atom of

coal to come in contact with the proper amount of air.

So much for the advantages of pulverized coal. There are disadvantages, however, which in some cases make it absolutely impossible; for instance, where it is essential to allow the products of combustion to mingle with the finished product. If the foreign matter, such as ash and suphur, are detrimental, pulverized coal will, of course, be impractical; however, the fact remains that 80 per cent of the cement kilns in the United States are operating with pulverized coal, and a small amount of ash mixing with the cement product does not seem to seriously interfere.

There are other instances where it is impracticable to use pulverized coal under present conditions; for example, small installations in industrial locomotives, locomotive cranes, steam shovels and drag lines. In these, however, great economy should be exercised in the choice and preparation of the coal. In place of using slack or mine-run, or even screen coal, the greatest possible advantage can be gained, in firing on grates, by buying the lump coal and crushing it with the proper kind of coal crusher, either of the jaw type or the impact type, as above described.

The best results can be obtained where the coal ranges from ¼ in. to 1¼ in. with the least amount of fine dust. This will give an unobstructed draft, will improve combustion and will reduce the loss from unconsumed carbon. The cost of installation of the impact crusher for this class of work is so low that it is within the reach of every consumer. It can be made to fit into any conditions and will pay for itself in a very short time in actual saving of coal.

Quarry Accidents.

According to a report just issued by the Bureau of Mines (technical paper 193) accidents at quarries during 1916 showed an increase in number and rate of fatalities. This does not indicate, however, that the hazard of the industry is increasing, but rather that the requirements of state compensation laws are bringing out the real facts. The number of fatalities reported was 173 as compared with 148 in 1915, whereas the total number of employees reported was 90,797 as compared with 100,740 in the preceding year. The fatality rate was 2.26 as against 1.80. Non-fatal injuries also increased from 117.30 per thousand workers to 175.62. In the tables from which these figures are taken the number of employees has been reduced to the equivalent of 300-day workers, the actual number of hours worked, however, per man, averaging approximately only 240 hours.

The figures for limestone quarries, by causes and states, are compiled from the reports of 1,247 operators, employing 41,355 men (34,809 300-day workers), of whom 31,962 were employed in the quarries and 9,393 outside of the quarries. The average number of days worked in 1916 was 253, as compared with 238 in 1915. The total reported deaths and injuries due to accidents are as follows: Number of deaths, 82, or 2.36 per 1,000 (300-day workers); number of injuries, 6,130, or 176.10 per 1,000 (300-day workers).

Of the fatalities in limestone quarries in 1916 14 are ascribed to falls or slides of rock or overburden; 2 to handling rock at face; 16 to explosives; 8 to haulage; 2 to falling into quarry from surface, benches or face; 1 to falling from hoists, derricks, etc.; 7 to electricity; 1 to machinery; 1 to flying pieces of rock from sledging; 3 to flying or falling objects (rocks, timbers, etc.) in outside works; 5 to railway cars and locomotives; 3 to crushers; 3 to cranes, derricks, etc., in outside works, and 8 to other causes.

Mistakes.

When a plumber makes a mistake, he charges time for it.

When a lawyer makes a mistake, it's just what he wanted.

When a carpenter makes a mistake, it's just what he expected, because the chances are ten to one he never learned his business.

When an electrician makes a mistake, he blames it on induction, because nobody knows what that is.

When a doctor makes a mistake, he buries it.

When a judge makes a mistake, it becomes the law of the land.

When a preacher makes a mistake, nobody knows the difference.

But a Salesman—he is different: he has to be careful, he cannot turn his mistakes into profit or blame them on a profession.

You've got to go some to be a Salesman. —*Du Pont Magazine.*

Labor-Saving in Limestone Quarrying

By Oliver Bowles.*

(*FIRST INSTALLMENT. The second and concluding installment will appear in the December issue.*)

THE nation's normal industries have suffered considerably on account of labor shortage occasioned by the mobilization of men to form a great army and navy, and by the development of special industries to supply their needs. The quarry industries are no exception to this rule, for many men, both skilled and unskilled, have been taken from them by enlistment or by the selective draft. In addition to losses through ordinary enlistments, the formation of a regiment (the 28th Engineers) consisting entirely of skilled quarrymen has further reduced the working strength. Hence the time is opportune for the Bureau of Mines to disseminate whatever information it may possess that will in any way assist quarrymen in their efforts to produce a maximum of rock with a minimum of labor. The purpose of this treatise is, therefore, to direct the attention of quarrymen to the most successful and efficient labor-saving methods and machines. Although many such devices are now in successful operation, there are few companies that cannot in some way modify their methods or equipment so as to conserve labor.

WHILE it is a difficult matter to properly judge the relative military importance of various industries, it is comparatively easy to select certain industries that contribute definitely and materially to the nation's military strength. Various branches of the limestone quarrying industry fall in the latter class. Many quarries produce stone for concrete aggregate, for cement or lime, or for road material, all of which are more or less directly concerned in the military program, and there is one branch of quarrying that is directly associated with an industry of vast military importance.

The heavy demand for iron and steel occasioned by the war has kept the iron smelters of the United States employed at maximum capacity. The increased activity in smelting is reflected in a corresponding increase in the demand for fluxing limestone. According to statistics compiled by the United Stataes Geological Survey, the production of blast-furnace flux in the United States during 1916 amounted to 23,603,508 tons, valued at $13,936,882, an increase of 24 per cent in volume and 44 per cent in value over that for 1915, and the increase during 1917 has evidently continued at about the same rate. In August, 1918, the statement was made in a technical journal that the production of fluxing limestone had then reached 120,000 tons daily. The increased demand for flux is occasioned partly by the increase in iron production and partly by a wider use of siliceous ores that require a high proportion of flux. As adequate supply of fluxing limestone is absolutely necessary in iron smelting, limestone quarrying ranks among the most essential industries.

Demand for Labor-Saving Devices.

The demand for a greatly increased production of fluxing limestone, combined with a labor shortage, creates an acute situation that demands relief. One obvious means of relief is to substitute mechanical equipment for labor. Fortunately, many such substitutes are not only known but have passed the experimental stage and are now in successful operation in many places. Labor may also be conserved by simplification of method, by efficient blasting, and in various other ways. Quarry operations should be planned so as to avoid all methods that place an unnecessary burden on labor. Thus excessive rehandling of material, com-

*From a pamphlet (War Minerals Investigations Series, No. 1) issued by the Bureau of Mines.

plexity in transportation systems, and loss of time through conflict of various operations should be avoided. Where this can be accomplished by modification of method, involving no heavy expense in the purchase of new equipment, it is a type of labor-saving that demands special encouragement.

Objections to the purchase of new mechanical equipment at this time are: The shortage of supply owing to the demand on machine shops to manufacture war material, the heavy demand for iron and steel, and the high cost of machinery. Many operators, however, are fully convinced that certain types of quarry machinery offer sufficient advantages to encourage their purchase even under present unfavorable conditions.

Many of the methods and types of equipment discussed in the following pages are applicable only to quarries of considerable size; for operators having limited capital would scarcely be justified in purchasing expensive equipment. However, a small and simplified modification of the more elaborate equipment designed for large quarries could probably be substituted to advantage for hand methods in many small quarries.

Quarry Plan.

The method of opening a quarry may have a direct bearing on the economy of labor in developing it. The depth of stripping to be removed should be carefully noted and an effort made to develop the quarry in a direction that requires a minimum of stripping.

All rock structures should be carefully considered, for their presence may greatly influence the ease of rock removal. In one New York locality, for example, the limestone beds dip about 4 degrees, and the quarry was opened in such a manner that development took place down the dip. As a consequence, accumulations of water at the working face after every heavy rain caused a temporary suspension of operations with consequent loss of labor. Had the quarry been opened in such a manner that development proceeded in the opposite direction, the water would have drained away, and no accumulation at the face would have been possible.

Planning a quarry so as to utilize rock structures to best advantage may greatly economize labor. Where limestone lies in approximately horizontal beds the utilization of an open bed plane for the quarry floor, or a bench floor, not only makes blasting easier, but the smooth surface that results requires little or no grading or ballast for tracks, and track-laying may be accomplished with minimum labor. A smooth floor also facilitates rock-loading.

The quarry, crusher and storage bin should be so situated that transportation may be simple and direct, and the force of gravity should be utilized wherever possible.

Stripping.

Limestone quarried for blast-furnace flux must be as free as possible from siliceous impurities. Commonly the permissible silica content is limited to 2 per cent. As large a proportion as possible of the quarry overburden, consisting of clay, sand, gravel, boulders, or mixtures of these materials, all containing a large percentage of silica, must, therefore, be separated from the rock.

The removal of overburden is accomplished in many different ways, the variations in method depending greatly on quarry conditions. The amount of overburden to be removed may vary from a few inches to twenty-five or thirty feet. Obviously, methods employed for the removal of a few inches of foreign material would not be applicable for the removal of a depth of several feet. Stripping methods are influenced by the nature and depth of the overburden, and also by the nature of the rock surface, by the convenience of the dumping-ground, by water supply and drainage, and by the amount of capital available for stripping equipment.

Overburden Shot Down With Rock.

Operators of quarries in rock deposits with overburden limited to a few inches in thickness may be justified in shooting down the overburden with the rock and in separating rock and waste material by a subsequent operation. Where seams or erosion cavities are filled with clay, sand or gravel, the difficulty of removing the waste material before rock blasting may render it necessary to blast rock and waste material down together, and to separate the siliceous material from the good limestone at a later time. Such

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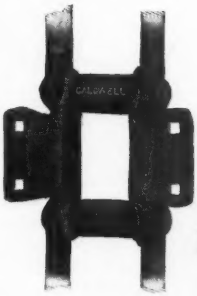

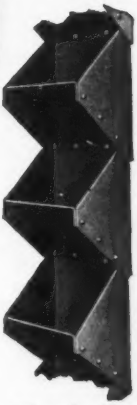

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subsequent separation may be accomplished by either of two methods.

According to the first method the rock fragments are loaded into cars by hand, and accumulations of debris are loaded in the same way. For small quarries such procedure may be justified, but under conditions of labor shortage the method is too slow and laborious to be recommended for quarries of any considerable size.

The second method is in common use in the larger quarries. The rock fragments, together with waste material, are loaded with a steam shovel, a method that is economical of labor, and the separation of good rock and waste is accomplished by screening or by washing in conjunction with screening. From the standpoint of labor saving, this method is greatly to be preferred. One objection to the method is the waste that results from the finer rock fragments passing through the screens with the debris, though this waste may be partly overcome by screening the rock to various sizes and discarding only the finest grade of material.

Removal of Overburden Before Quarrying.

While shooting down rock and overburden together, and subsequently separating them by sorting, screening or washing, may, as stated above, be justified under certain circumstances, the removal of overburden prior to rock blasting offers definite advantages.

In their natural occurrence serviceable rock and waste material are as a rule distinct, and are separated by a well-defined boundary. An exception to this rule is the occurrence of clay seams or pockets in the rock ledge. Where any considerable amount of debris is originally unmixed with the rock, it is obviously a poor policy to mix rock and waste by blasting them down together when their subsequent separation is demanded. It involves unnecessary handling of waste, and in rainy seasons the presence of sticky clay with rock impedes operations and renders separation difficult. A better plan is to remove overburden as completely as possible before blasting the rock ledge.

Various methods in common use for the removal of stripping have been described in other publications of the Bureau of Mines. The purpose of the present publication is to give special consideration to their respective labor requirements.

Various Methods Compared.

Loading waste material into dump carts or cars with hand tools is doubtless recognized by most quarrymen as involving the most prodigal use of labor, per ton of material removed, of any method in common use. Fortunately, it is not commonly employed except in very small quarries.

Where the overburden rests on a reasonably smooth rock surface, and the dumping ground is near by, the employment of teams and scrapers results in a pronounced saving of labor over hand methods. Where the waste must be moved a considerable distance a method has been noted whereby the scraper loads are dumped through an opening into wagons on a depressed roadway, the soil being thus handled in two operations. Under such circumstances wheeled scrapers are to be preferred, for thus a single operation will suffice, and such simplification reduces the labor requirement.

A drag-line scraper alone has been used effectively where conditions are favorable, and a drag-line scraper used in conjunction with dump cars, as described in Bulletin 160, may be used to advantage. By either method the heaviest burden of the work is accomplished by machinery, and the labor requirement is not high.

The most popular stripping equipment for large quarries is the steam shovel. It requires a small gang of men, and when properly handled and well supplied with cars can load a great mass of material in a day. Efficient service depends on strong mechanical construction, adequate care, and operation by a skilled runner. Where inefficiency in steam shovel operation is in evidence it usually results from inadequate car service for removal of loaded material rather than from improper handling of the steam shovel itself.

While the first cost of a steam shovel is high, with proper care the cost of maintenance is not excessive. Where the rock surface is fairly uniform and level the steam shovel is probably the best equipment for loading any considerable thickness of overburden.

A stripping conveyor to be used in conjunction with a steam shovel is illustrated and described in a former publication. Such equipment cannot

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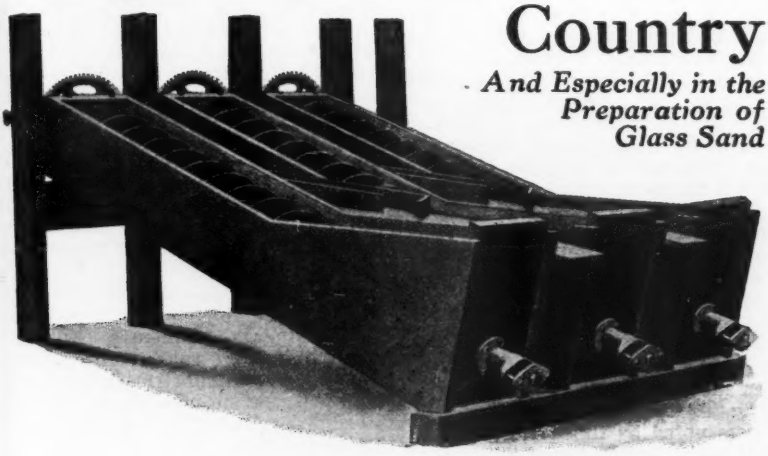

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be generally employed, for it is applicable only to quarries where the overburden may be conveniently disposed in the pit formed by removal of the good rock.

With adequate water supply, proper drainage, and sufficient waste-disposal area, hydraulic stripping is probably the most economical of labor of all methods in common use. With two men at the pumping station and two to handle the nozzle, a great mass of debris may be washed down in a single day. The rate of removal depends on the size of the nozzle, the available water pressure and the consistency of the soil. The rate of progress may be retarded if the overburden is hard, for it may be necessary to bore it with a soil auger and blast with powder. The presence of numerous boulders may also render hydraulic stripping difficult.

As labor is the chief cost item in stripping, the cost per cubic yard is a fair indication of the relative labor requirements of various processes. The following figures representing minimum costs noted by the writer during field investigations may be of interest in this connection: Hand shovel and dump cart method, 30 cents per cubic yard; steam shovel and cars hauled by dinkey engine, 16 cents; steam shovel and stripping conveyor referred to above, 3 cents; drag-line scraper (to loading platform only), 3 cents; hydraulic stripping, 3 cents.

Labor Economy in Drilling.

For multiple-bench or snake-hole quarrying tripod drills are generally used, though of late years large hammer drills have been used successfully by many operators. For ledges not exceeding forty feet in thickness wagon drills are successfully employed in a few localities. For single-bench quarrying, with the quarry face twenty-five feet or more in height, churn drills are now widely used.

Tripod drills require two men each, a runner and a helper, except that in some instances one helper is deemed sufficient for two drills. Hammer drills require no helpers, and are, therefore, more economical of labor than tripods. Wagon or churn drills usually require two men each, though some electrically operated churn drills employ only one man each.

The churn drill, while it is a comparatively recent type of equipment in limestone quarries, is rapidly gaining in favor and is in successful use in a great many places. While there are conditions where it is claimed that other types of drills render better service, from the standpoint of labor requirements the churn drill has this advantage, that it accomplishes the work of four or five tripods or hammer drills with no greater labor than is required for a single tripod. A quarry operator in Pennsylvania claims that one churn drill, one tripod and one hammer drill accomplish as much as was formerly done in the same quarry with five tripods and three hammer drills. Estimating the labor requirement conservatively, the old method would require eleven men and the new method five.

One Texas operator reports that when he employed five tripod drills his plant was frequently shut down through lack of rock; and when one churn drill was substituted for the five tripods the plant was continually supplied, and the drill was used part of the time only.

As in the case of stripping, the relative direct cost of drilling with various types of equipment is a fair measure of their relative labor requirement. S. R. Russell,* in an article entitled "Loading and Shooting Big Blast Holes," estimates that the average cost of steam tripod drilling is about 8 cents per cubic yard of rock quarried, while the average cost of churn drilling is about 2 cents. These figures indicate that the churn drill promotes labor economy.

When churn drills are employed, not only is there a decided saving of labor in the actual drilling process, but their employment may also result in a marked saving of labor in other departments. Where tripod drills are employed in deep quarries the face must be worked down in a series of benches. Bench cleaning is, therefore, necessary, and tracks must be moved frequently. One quarryman reports that the introduction of churn drills released fifteen men formerly employed in operations now rendered unnecessary by the introduction of the new equipment.

*"Blast-hole Drilling with Keystone Cable Drills," published by Keystone Driller Co., Beaver Falls, Pa.

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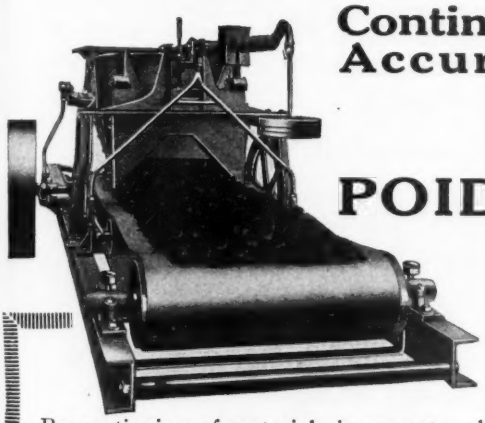

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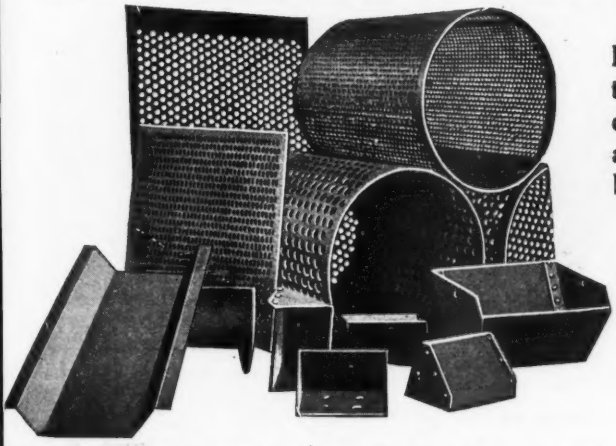

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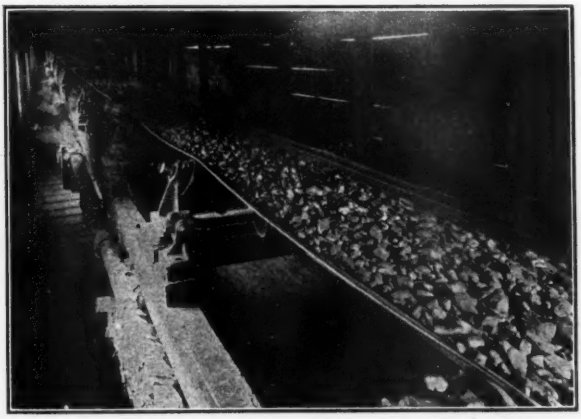

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THE BROKENSWORD STONE CO., Bucyrus, Ohio, knows PLYMOUTH Gasoline Locomotives. This Company has had one outfit since 1915, and a second PLYMOUTH was bought later. The Locomotives run on a 36-inch gauge track, and make 3000-foot hauls under load. Handling from 500 to 700 tons per day, they consume but 7 gallons of gasoline each and require but a minimum of attention. The owners say:

"The PLYMOUTH is the Best Industrial Locomotive on the Market"

The haul includes some sharp curves and the tracks are more or less irregular—none of which have made any difference to The Brokensword Stone Co.'s PLYMOUTH.

Write now for particulars about PLYMOUTHS and their work in the service of firms right in your own and allied lines—companies who bought them only when absolutely convinced that they would reduce expenses, increase output, and stabilize conditions all around.

We'll gladly send you the facts—without obligating you in the least. Why not write for them *now?*

THE J. D. FATE COMPANY

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Sales Representatives in all Principal Districts

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THE MICHIGAN HOIST IS A GIANT FOR WORK

It is a time and money saver in heavy dock work and stationary hoisting of all kinds. Occupies only five square feet of floor space.

Operated with one lever and is instantly reversible. Equipped with a friction for fast lowering if desired.

Built for long service and hard wear. The two cylinders have well-fitted, easy-running pistons and all connecting rods and crank are made of the best steel obtainable.

All bearings heavily babbitted—driving gears are perfectly fitted and lined up so as to run smoothly, properly shielded by guards.

The two winch spools are 10 inches long—the drum is 14 by 26½.

We can make prompt shipment if we receive your order soon.

READY FOR IMMEDIATE SHIPMENT

Yours for Hoisting Service

Michigan Dredge Co.

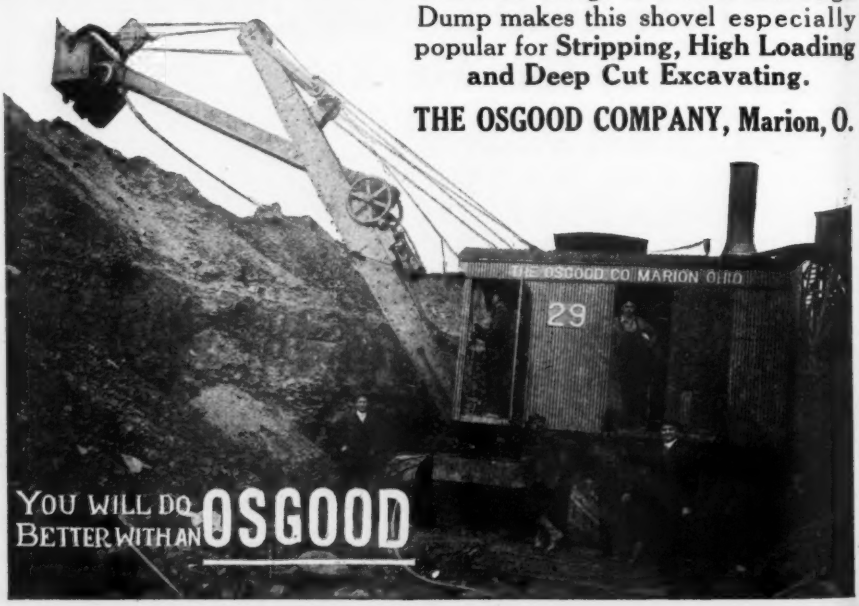
Bay City, Mich.

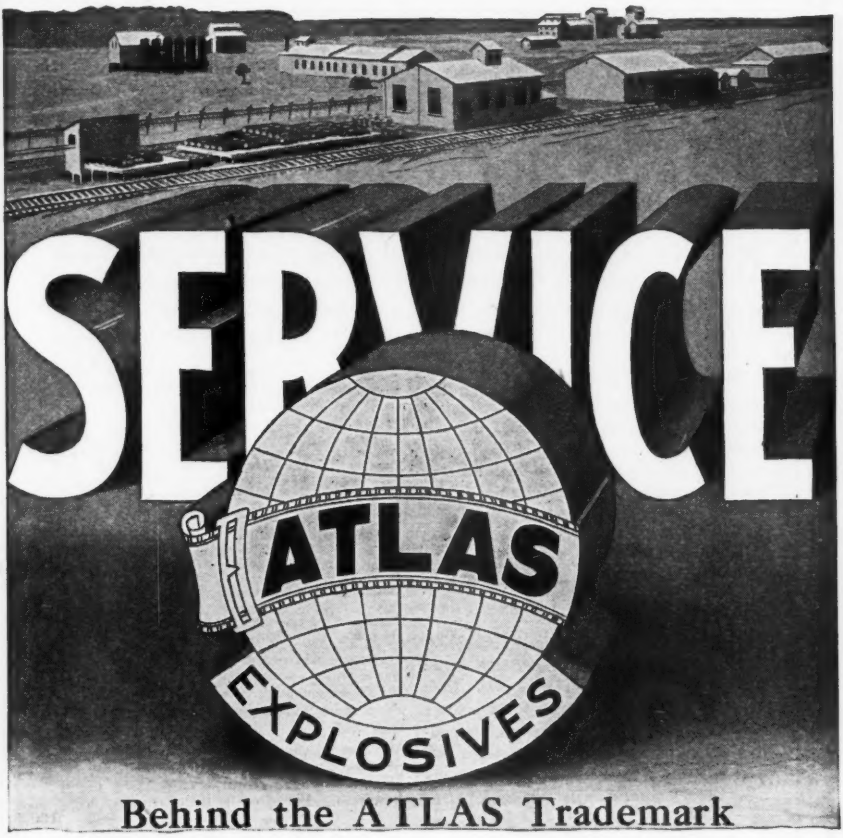
OSGOOD "29"

1-Yard Traction Revolving Steam Shovel

The wide range of action and High Dump makes this shovel especially popular for **Stripping, High Loading and Deep Cut Excavating.**

THE OSGOOD COMPANY, Marion, O.





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ATLAS service stands pre-eminent. And behind this super-service stands the ATLAS organization of experts bending every energy to make *your* blasting more efficient and more economical.

We have the benefit of more than a century of experience in making explosives. This experience is yours for the asking, to help *you* solve your blasting problems. This definite personal service has cut the cost of blasting for so many of our friends that we are confident it will do the same for you, no matter what the nature of the blasting may be or the special conditions that must be met.

There is a proper ATLAS explosive for each individual blasting requirement. Our tests guarantee every pound for quality and uniformity. You can depend on ATLAS always to give absolutely uniform results under similar conditions.

Your blasting requirements cannot be too large or too small for you to profit by ATLAS service. Just put your problems up to us and we will point the way to better and cheaper blasting.

ATLAS POWDER COMPANY

Home Office: Wilmington, Del.

Sales Offices: Allentown (Pa.), Birmingham (Ala.), Boston, Chicago, Houghton (Mich.), Joplin (Mo.), Kansas City, Knoxville, McAlester (Okla.), Nashville, New Orleans, New York, Philadelphia, Pittsburg (Kan.), Pittsburgh (Pa.), Pottsville (Pa.), St. Louis, Wilkes-Barre (Pa.).

A PROPER EXPLOSIVE FOR EVERY BLASTING REQUIREMENT

Put your blasting problems up to us

Our Service Department is a clearing-house of blasting experience in all its phases and under all conditions. It is directed by experts who will personally help you apply this vast store of information to your own blasting. WRITE TODAY.

Wanted:—Men to Discover America

A Statement by Franklin K. Lane, Secretary of the Interior

MANY of the resources of our country lie undiscovered and undeveloped. In these days of great needs and great deeds men are wanted—men of ability, initiative, and imagination—to discover these resources and put them at the Nation's service.

Undeveloped Resources

The undeveloped resources to which I particularly refer are those with which I am most familiar through the activities of the Department of the Interior—metals and minerals which we require in large quantities, which exist in large quantities in this country, and which, in spite of this, are largely imported from abroad.

What They Are

We must have chrome, manganese, and pyrite. Our chrome comes mostly from South Africa and New Caledonia; our manganese from Brazil; our pyrites from Spain. To produce some two million tons of these and other imported minerals from domestic sources will release from three to four hundred thousand tons of shipping for military use.

Where They Are

Will you save Ships for the transporting and feeding of our armies by discovering and developing our own deposits of these minerals? They are to be found in the following localities in the United States, which are tributary to a possible market.

PYRITES

Virginia		Minnesota
New York	Tennessee	South Dakota
Georgia	Pennsylvania	Colorado
Alabama	South Carolina	Illinois
Wisconsin	New England States	Indiana
Missouri		Ohio

MANGANIFEROUS IRON ORE

Minnesota Colorado Nevada New Mexico

MANGANESE ORE

Montana Arizona Utah Wyoming New Mexico
Washington Virginia Idaho Nevada California
Oklahoma Tennessee Georgia Oregon Arkansas

CHROME ORE

California	Georgia	Wyoming Maryland
Oregon	Pennsylvania	North Carolina

One man in Georgia last year developed five pyrites mines without a cent of subsidy from the Government: and he was a manufacturer, not a miner. Many others can do likewise if they will.

We are discovering that many minerals we need we have in the United States. But we have hardly begun to develop these minor resources. Let us get at it in earnest.

Secretary of the Interior.

The Hercules Powder Co. welcomes the opportunity to put before you this statement by Secretary Lane. The latent resources of our country to which he refers fall within the field of a great national industry—the mining of metals and minerals—with which we are very closely allied. A large part of the explosives which we make are used by the miners of the country—men to whose initial energy the United States owes vital factors in the present crisis, its ships, its motors, its tanks, its cannon; in fact all its implements of active warfare.

HERCULES POWDER CO.

Chicago Hazleton, Pa. Memphis Pittsburg, Kan. Salt Lake City St. Louis
Denver Joplin New York Pittsburgh, Pa. San Francisco Wilmington, Del.

DU PONT AMERICAN INDUSTRIES

Keep the Quarries Going All Winter

THE maintenance of highways for war-time trucking calls for stone and more stone. There should be no let-up at the source of supply. The use of Red Cross Explosives in quarrying will enable blasting operations to proceed without interruption through the coldest weather. There are few blasting jobs that cannot be accomplished by

Red Cross Explosives

and they have the added advantage of being low-freezing.

Extensive field study has brought to the Du Pont Company an intimate knowledge of quarry problems and their solution.

Efficient and economical methods for benching, snake-holing, well-drilling and gopher-holing are described in detail in "Modern Quarrying." A copy of this booklet will be sent free on request.

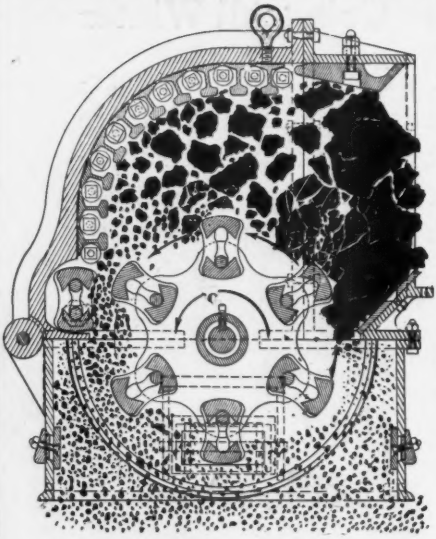
E. I. du Pont de Nemours & Co.

Powder Makers Since 1802

Wilmington, Delaware

DU PONT

Brainard Impact Coal Crusher



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Uniform Size
With less than **7%** under 1-4 inch

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Cement Mill Tires and Rolls

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"ADAMITE" A high-carbon alloy of chromium and nickel made under the U. S. and Foreign Patents. It is hard, yet tough, strong and resists wear and abrasion better than any other material.

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